RED STAR VOLUME 11

Myasishchev M-4 and 3M

The First Soviet Strategic Jet Bomber

Yefim Gordon

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Original translation by Dmitriy Komissarov

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Title page: This view of the first prototype M-4 ('25 Red', c/n 0001) as it 'cleans up' after take-off illustrates well the bomber's elegant lines.

Below: An M-4-2 tanker ('62 Red', c/n 5300508) is refuelled for a training sortie. Note the 'Excellent aircraft' badge (awarded for maintaining the aircraft in perfect technical condition) on the nose gear door.

Introduction

During the immediate pre-war period and in the years of the Great Patriotic War (1941-45) the attitude of the Soviet leader Iosif V. Stalin towards strategic aviation (ie, long-range bombers) was inconsistent, to say the least. Production of the Petlyakov Pe-8 four-engined bomber, an innovative design by the standards of the late 1930s (alias TB-7 for *tyazholyy bombardirovschchik* – heavy bomber, or ANT-42 – this latter because Vladimir Mikhaïlovich Petlyakov then worked as an aide to Andrey Nikolayevich Tupolev), was by turns terminated and relaunched several times. Failing to find government support, another Soviet bomber designer, Vladimir Mikhaïlovich Myasishchev, proceeded at his own risk with the development of the DVB-102 long-range high-altitude bomber (*dahl'niy vysotnyy bombardirovschchik*) in the early 1940s. This aircraft incorporated an amazing combination of advanced features, including two pressurised cabins for the crew, remote-controlled powered gun barbettes, integral fuel tanks in the wing torsion box, etc. The design effort, which proceeded throughout the war, culminated in flight tests of a prototype, earning Myasishchev and his team the personal gratitude of Stalin and various government awards.

Nonetheless, in the spring of 1946 the DVB-102 programme was cancelled – officially for want of a suitable powerplant (development problems with the bomber's intended 1,800-hp Klimov M-120TK 18-cylinder Y-block in-line engines meant that early testing had to be undertaken with Shvetsov M-71 radials rated at 1,600 hp, with which the aircraft could not meet the design specifications) – and the design bureau of plant No. 482 headed by V. M. Myasishchev was dissolved. The entire premises and manufacturing facilities of the defunct OKB-482 (*opytno-konstrooktorskoye byuro* – experimental design bureau: the number is a code allocated for security reasons) were transferred to Sergey Vladimirovich Il'yushin's OKB-240, while the OKB staff and the workforce of plant No. 482 found themselves scattered far and wide across the country to work at other aviation industry enterprises.

A few years later Il'yushin, who had several bomber programmes of his own, found himself in a similar situation: his OKB was not closed down, of course, but he received an offer which he could not refuse (from the government, that is) not to develop any more strategic bombers. The totalitarian state had its own methods of 'fair competition'. Whereas in the notorious 1930s massive repressions and purges were used to clear the way for whichever design team was in favour at the time, in the immediate post-war years (the late 1940s) the Soviet government displayed a little more finesse, reducing the number of defence industry enterprises on the pretext that in peacetime there was no longer a need for so many. (Somehow this brings to mind a line from a song by Sting called 'Murder by Numbers': *There isn't really any need for bloodshed, // Just do it with a little more finesse; // If you can slip a tablet into someone's coffee, // Then it avoids an awful lot of mess.*) In so doing the capabilities of the Soviet aircraft industry were severely restricted by funding cutbacks; as a result, experimental aircraft construction was limited to a handful of major design bureaux. OKB-156 led by Andrey N. Tupolev, a man who enjoyed considerable authority in the Kremlin, became the 'official purveyor to the court' insofar as strategic bomber development was concerned.

The Second World War had hardly ended when the world found itself in the throes of a new conflict – the confrontation between East and West known as the Cold War. This term, coined in 1947 denoted political, economic, ideological and military confrontation stopping short of outright armed conflict. Some hotheads, however, were not content to stop short. Since the fearsome nuclear bomb was now the decisive argument in the dialogue (or rather quarrel) of the two superpowers, this was the time when the USA started drawing up plans for pre-emptive nuclear strikes against the USSR and its allies. Operation *Dropshot* alone envisaged dropping 300 nuclear bombs and 29,000 conventional high-explosive (HE) bombs on 200 targets in 100 cities and towns to wipe out 85% of the Soviet Union's industrial potential at a single stroke. Between 75 and 100 of these 300 nukes were intended to destroy Soviet combat aircraft on the ground.

How could the USSR oppose these bloodthirsty plans and the armadas of US Air Force strategic bombers? Only a comparable force, of course. As the call, so the echo.

The DVB-102 was the first design of Vladimir Myasishchev's newly-established OKB-482 and a truly advanced aircraft in its day, but it was prevented from entering production by the unavailability of its intended engines.

Above: General Designer Andrey Nikolayevich Tupolev (1888-1972), head of OKB-156 and Myasishchev's chief competitor.

In the late 1950s the Soviet Union's sole means of delivering nuclear munitions was the Tupolev Tu-4 strategic bomber; known to NATO under the reporting name *Bull* (B for Bomber), this was a straightforward unlicensed copy of the Boeing B-29A Stratofortress. However, born in a remarkably short time, the piston-engined Tu-4 was growing obsolete just as rapidly. The Soviet aircraft industry responded immediately by developing new bomber types; however, the legacy of the Tu-4 (or perhaps the inertia of thought) was so strong that in designing new bombers capable of reaching across the North Pole the Tupolev OKB still relied on piston engines for a while. The result was predictable: the Tu-80 showed disappointing performance. The OKB made a final effort, evolving the Tu-80 design into the Tu-85 long-range bomber powered by four 2,500-hp Dobrynin VD-4K 24-cylinder X-block in-line engines. Even though this aircraft, which first flew in January 1951, did achieve the specified performance (indeed, preparations for series production were in hand for a brief period), it was clear that the days of the 'corncob engines' were over. To top it all, the Tu-85 used an outdated configuration with inefficient tractor airscrews. In the US the piston age in strategic aviation had ended by then; consider also that the ultimate American piston-engined bombers – the famous Northrop XB-35 'flying wing' and the equally famous 'six-turning, four-burning' Convair B-36 Peacemaker – utilised a more complex but also more efficient arrangement with pusher propellers. Also, the outbreak of the Korean War in 1950, a conflict in which prop-driven aircraft were pitted against jets (and lost, on most occasions), made the military on both sides of the Iron Curtain change their attitude towards piston-engined aircraft.

On 28th February 1951 Soviet Air Force Commander-in-Chief, Air Marshal Pavel F. Zhigarev reported to Stalin as follows:

'Combat experience gained in Korea when using [Mikoyan/Gurevich] MiG-15 jet fighters against American B-29 aircraft shows that bombers of this kind are relatively defenceless (sic) when confronted by modern high-speed jet fighters.

Above: General Designer Vladimir Mikhaïlovich Myasishchev (1902-1978), head of OKB-23. He is seen wearing his Major General's uniform.

'Captured American airmen from a [downed] B-29 state that the crew of an American bomber is unable to track attacking MiG-15s with their guns and fire on them accurately.

'This circumstance makes it much easier for MiG-15 pilots to attack B-29 bombers due to the latter's relatively low speed. As a result, the MiG-15 usually comes out as the winner in air-to-air combat between the two types. [...]

'In five aerial engagements with a numerically superior adversary MiG-15 fighters have shot down ten American B-29s and one [Lock-

The Tupolev Tu-4 (a copy of the Boeing B-29) was the Soviet Air Force's main heavy bomber at the time when Myasishchev designed his M-4. Here is an impressive line-up of Tu-4s serialled '32 Black' (c/n 220702), '39 Black' (c/n 220804), '37 Black' (c/n 220802), etc.

heed] F-80 [Shooting Star]. No MiG-15s have been lost in these engagements.

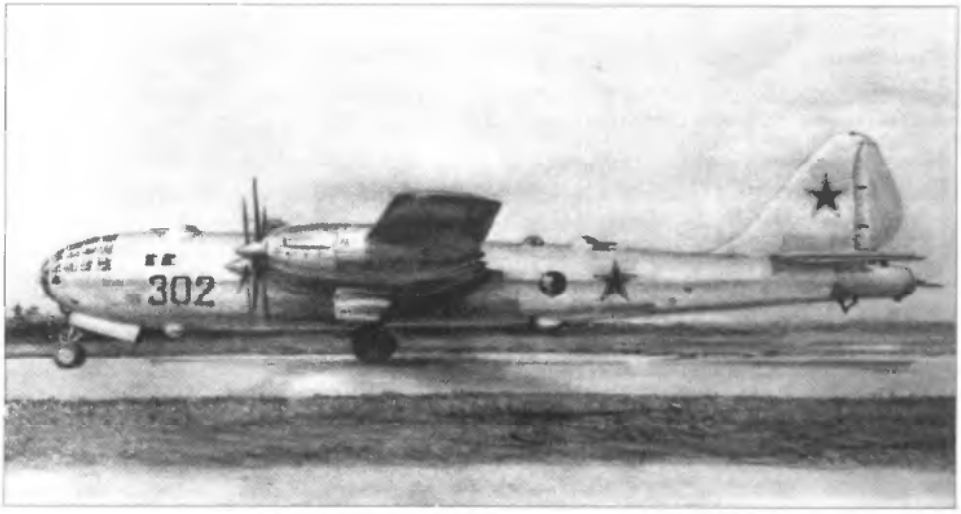
'In view of the facts stated above it is alarming that our Tu-4 bomber possessing closely comparable performance to that of the B-29 (and well it might – *Auth.*), *including a top speed of 560 km/h* [350 mph], *may prove to be relatively defenceless in wartime when attacking enemy targets which are defended by modern jet fighters.*

'It is equally alarming that the new four-engined bomber developed by Comrade Tupolev which is currently undergoing trials (the Tu-85 – *Auth.*) *and has shown a maximum range of 12,000 km* [7,450 miles] *and a top speed of 600 km/h [370 mph], will have much the same deficiencies as the Tu-4.*

'Having a considerable difference in speed with jet fighters (in plain language this means 'being much slower' – *Auth*), *during deep penetration missions the Tu-4 and the new bomber will be repeatedly attacked by enemy fighters, to which,* as *Korean combat experience shows, they will be unable to put up effective resistance and thus reach their target without suffering heavy losses.'*

Meanwhile, the Western world continued to steadily build up its combat jet fleets. In Great Britain the 'V-Bombers' (the Avro 698 Vulcan, Handley Page HP.80 Victor and Vickers Type 660 Valiant) were developed and put into service with the Royal Air Force. In the USA the Boeing Model 450 (B-47 Stratojet) first flew in December 1947, entering service in 1950, and Boeing was already working on the Model 464 – the future B-52 Stratofortress. Again the Soviet Union was facing the dire necessity not only to keep up with the Joneses but to overtake them in this field if at all possible.

The Soviet political and military leaders were extremely worried about the national aircraft industry being late in developing heavy swept-wing jets. In the 1980s, using the Soviet press as an instrument, certain people tried to create the impression that Andrey N. Tupolev, the patriarch and effective monopolist in heavy aircraft development in the Soviet Union, flatly refused to design swept-wing jet aircraft. Tupolev was even quoted as saying at a Kremlin conference chaired by Stalin himself that *'I will never ever design such an aircraft because the flutter phenomenon in large swept wings is totally unexplored and cannot be overcome at transonic speeds.'* Tupolev allegedly backed this statement with well-founded arguments based on research conducted in the USSR. Another publication claimed in earnest that Tupolev derided early reports on the B-52 as *'a lot of bluff from across the ocean'* and even remarked in a high-handed manner at the end of the said meeting, *'Come on, you already have me developing the long-range Tu-16 jet [bomber], and the piston-engined Tu-85 will suit our needs for years to come!'* The author alleged that Stalin was angered by this remark and made it patently clear that Tupolev would have to take on the job, whether he wanted it or not: *'If you have trouble, we will help you; if you refuse, we will force you!'*



Artist's impressions of two early designs proposed by Myasishchev in 1949 – the DVB-202 (above) and DVB-302. They were basically improved versions of the Tu-4, differing from each other only in engine type.

May the authors of those publications suffer from a guilty conscience. It is true that Andrey N. Tupolev was often conservative in his views; it is equally true that he was difficult to deal with. This, understandably enough, brought him his share of detractors; still, it is sad that after Tupolev's death such people would take pleasure in kicking the dead lion.

In reality things were a bit different, to say the least. The source which the newspaper authors alluded to was a letter from Tupolev to Stalin written in 1951 in which the Chief Designer stated his views on the subject. Suffice it to quote an abstract from this letter – the way it was really written. Tupolev wrote:

'The biggest problem to be overcome in the creation of a long-range fast heavy bomber is the need to reconcile high speed with long range. Therefore the first stage of our work was to determine the maximum speeds a swept-wing heavy aircraft can currently achieve, regardless of the power of the engines installed. It turned out that, judging by our experience and extensive research conducted by TsAGI (*Tsen**trahl'**nyy* ***a**ero- i **ghid**rodina**mich**eskiy insti**toot*** – the Central Aero- & Hydrodynamics Institute named after Nikolay Ye. Zhukovskiy) *the following maximum speeds can be attained with assurance, given the current state-of-the-art in* aero- & *hydrodynamics development:*

- 950-960 km/h [590-596 mph] *at 8,000 m* [26,250 ft];

- 885-900 km/h [550-560 mph] *at 12,000 m* [39,370 ft].

'Note: Even higher speeds are possible at lower altitudes, but these are not much use from a tactical standpoint.

'We have considered the possibility of reaching the target, using jet engines. This research allowed us to determine the effect of the aircraft's size, weight and engine power on

The sole prototype of the Tu-85 ('aircraft 85'), Tupolev's last piston-engined bomber. Even though it met the design target, the Tu-85 was not put into production because piston engines were considered obsolete by the early 1950s.

speed, altitude and range. Two different calculation methods were used in all cases to preclude incidental errors.

'The conclusion we reached is that it is possible to create a fast bomber, using jet engines. Yet, it would be extremely difficult to obtain a range in excess of 11,000-12,000 km [6,830-7,450 miles] *from such a bomber, as this would require development of a unique aircraft of extraordinary weight and size.*

'Thus, we are unable to find a reasonable solution to the task if jet engines are to be used.

'The appearance in the Soviet Union of indigenous turboprop engines developed by [Nikolay Dmitriyevich] Kuznetsov, which have passed State bench trials, has created the prerequisites for developing viable long-range bombers powered by turboprops. Calculations show that a reasonably-sized bomber (ie, with a weight of not more than 130-160 tons [286,600-352,730 lb]*) powered by turboprop engines can attain a much longer range than a jet aircraft; the range could be as long as 14,000-15,000 km* [8,700-9,320 miles] *or even 18,000 km* [11,180 miles].'

See the difference?

That said, you will surely agree it would be unfair to say Tupolev was refusing to design a jet-powered strategic bomber on the grounds that 'the flutter phenomenon in large swept wings is totally unexplored and cannot be overcome at transonic speeds'! What really made the patriarch back off was the lack of conviction (no pun intended) that the current state-of-the-art in jet engines would allow the aircraft to achieve the required range.

Indeed, at that time the experts of the Ministry of Aircraft Industry (MAP – *Mini**ster**stvo aviatsion**nnoy pro**mysh**lennosti*) and the Soviet Air Force (VVS – *Vo**yen**no-voz**doosh**nyye **see**ly*) were divided over the feasibility of creating a long-range swept-wing jet bomber. Not only Tupolev but other prominent Soviet aviation scientists had their misgivings, and the Soviet government was influenced to no small degree by these sceptics.

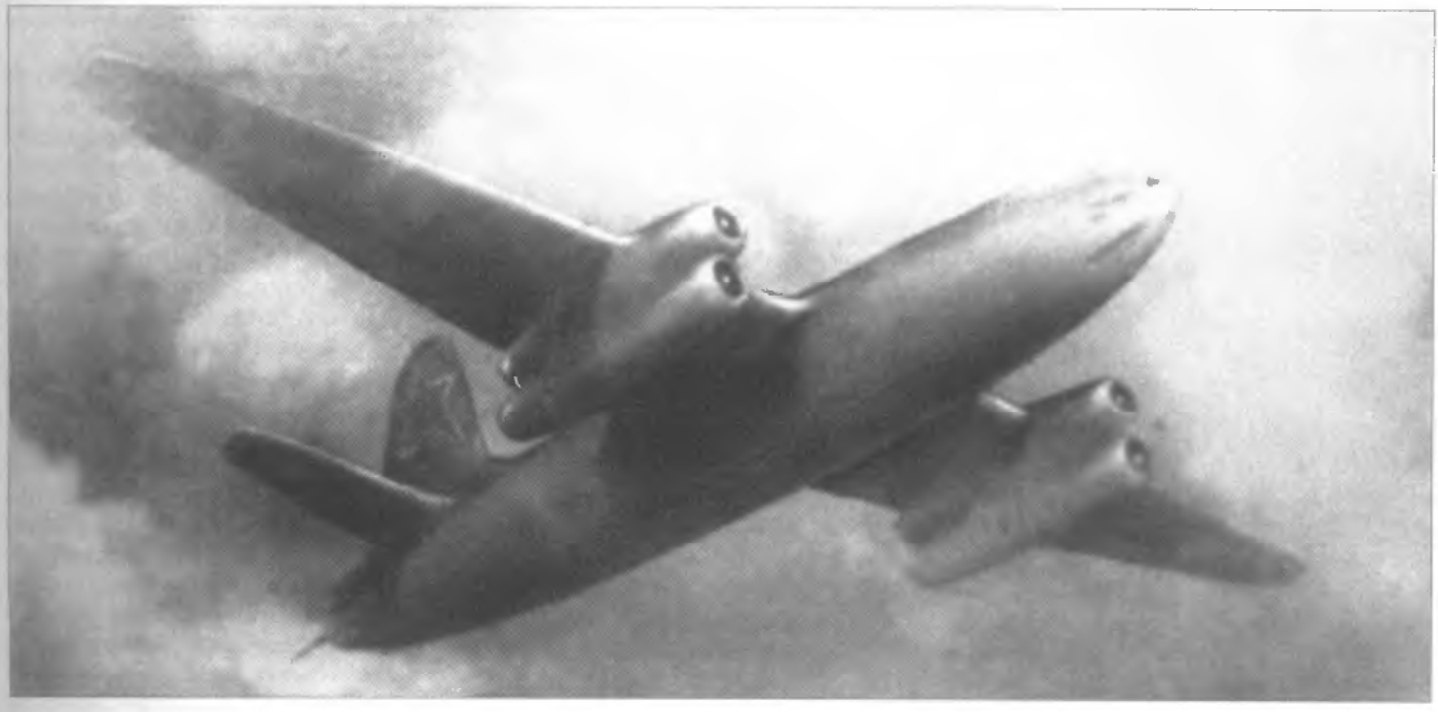
Vladimir M. Myasishchev, on the other hand, was one of the supporters. However, to prove the sceptics were wrong he had to see for himself if he was right and prove his point with rock-solid evidence. The first research and preliminary design (PD) studies of a strategic jet bomber began at his initiative as early as 1948.

After the closure of OKB-482 and his ousting from MAP, Myasishchev went on to work as dean of the aircraft design faculty at the Moscow Aviation Institute (MAI). However, he soon found himself at odds with the institute's Communist Party bosses; as a result, he was demoted to head of the fixed-wing aircraft design chair within the faculty. In this capacity he met Gheorgiy N. Nazarov, a highly skilled aviation engineer who would later become his closest aide.

Myasishchev's proposal to draw up a joint MAI/TsAGI research and development work plan on advanced aspects of aircraft design was an important step towards his return to the aircraft industry together with Nazarov. A major section of the plan was devoted to determining the parameters of future aircraft. This work was aimed at obtaining objective data which – now we come to the main point – would prove the feasibility of developing a long-range bomber with jet engines and high aspect ratio swept wings. The R&D effort involved a lot of calculations, graphs and PD layouts. In the course of 18 months (some sources say two years) the chair's engineering staff, assisted by ordinary and post-graduate students, managed to amass the necessary data from which to proceed with the strategic jet.

Then Vladimir M. Myasishchev delivered a report on the results of the parametric research programme at a session of TsAGI's Scientific and Technical Council. The session was chaired by Academician Aleksandr I. Makarevskiy and attended by such notable aviation scientists as Sergey A. Khristianovich, Vladimir V. Stroominskiy, Gheorgiy S. Büschgens (all three later became academicians as well) and others. After listening carefully to the report (followed by G. N. Nazarov's own report) and going over the details the Soviet aircraft industry's most authoritative institute gave the go-ahead, stating it was possible to create a strategic bomber with the stated performance characteristics obtained in the course of lengthy research. This was, in effect, the official launch of the aircraft initially known simply as the SDB (*strate**gich**esk**y **dahl'**niy bombardi**rov**schchik* – strategic long-range bomber).

The first proposals concerning the SDB were submitted by Vladimir M. Myasishchev in February 1951 when he was still heading the fixed-wing aircraft design chair at MAI. The Russian popular press quoted varying performance estimates for the projected bomber which was developed in several configura-

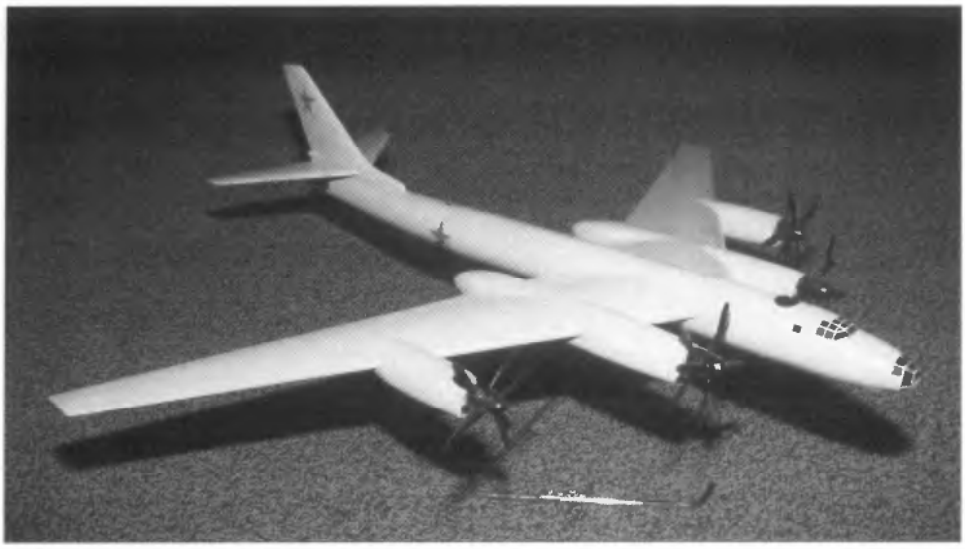


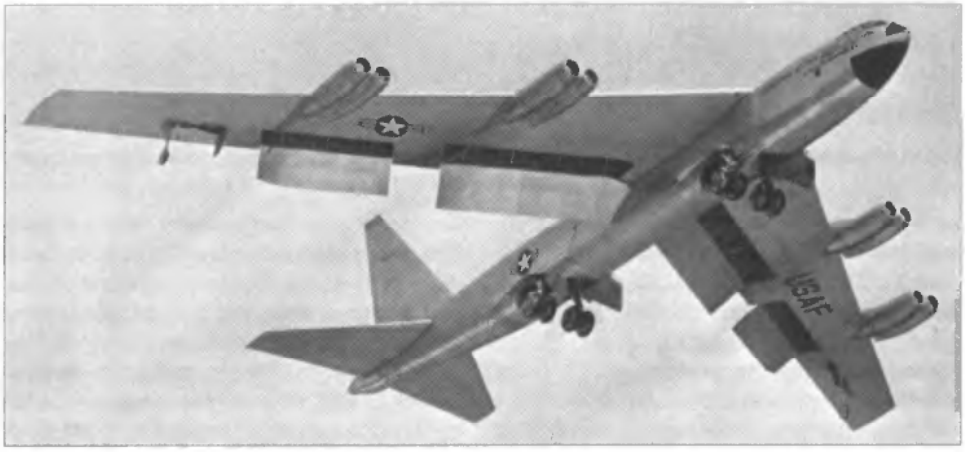
Above: An artist's impression of Myasishchev's DSB-17 (VM-24) four-jet bomber, sometimes called RB-17. This aircraft likewise never reached the hardware stage.

tions. One of the PD projects envisaged a powerplant of six 3,100-kgp (6,830-lb st) Klimov VK-5 centrifugal-flow turbojets; at a maximum take-off weight of 90 tons (198,400 lb) the aircraft was to deliver a 3-ton (6,610-lb) bomb load over a maximum distance of 12,000 km (7,450 miles) at a cruising speed of 750-800 km/h (465-500 mph). The proposal concerning the SDB bomber envisaged an even bigger and heavier aircraft; according to PD documents it would have a wing span of 50 m (164 ft), a 300-m² (3,225 sq. ft) wing area, an overall length of up to 44 m (144 ft 4¼ in), a normal take-off weight of 110 tons (242,500 lb) and an MTOW of 140 tons (308,640 lb). The design range was again 12,000 km but with a bomb load increased to 5 tons (11,020 lb). The maximum ordnance load was 20 tons (44,090 lb) and the aircraft could carry bombs of any calibre between 500 kg (1,102 lb) and 9,000 kg (19,840 lb). The cruising speed was set at 800-850 km/h (500 530 mph).

The SDB was a large aircraft utilising a conventional layout with shoulder-mounted swept wings, a conventional swept tail unit and four Mikulin AMRD-03 axial-flow turbojets; the only decidedly unconventional feature at first glance was the bicycle landing gear with outrigger struts retracting into the wingtip fairings. The wings had a cranked leading edge, with 45° leading-edge sweep on the inboard portions and 40° on the outer wings. The trailing edge featured a double kink due to different airfoil sections being used along the span and structural features intended to ensure adequate stiffness; the

The first prototype of Tupolev's 'aircraft 88' which entered production and service in 1952 as the Tu-16, becoming one of the mainstays of the Soviet Air Force's bomber component for the next three decades.





entire trailing edge was occupied by flaps and large ailerons.

The fuselage was of basically elliptical cross-section, providing a bomb bay that was large enough to accommodate two bombs of the largest calibre (eg, FAB-9000 HE bombs) one above the other. The rest of the internal volume was occupied by the two pressurised crew cabins, fuel tanks, wheel wells and equipment bays. Structurally the fuselage was built in five sections which were joined by bolts and flanges. The crew comprised two pilots, a navigator/bomb-aimer, two gunners using beam blisters ahead of the wings for sighting, a radio operator and a tail gunner.

The SDB was the largest and heaviest aircraft that had been designed in the USSR until then. It is certainly not common for a company developing the aircraft to take operational requirements to a new and higher level, but with the SDB this was the case. The Soviet government and the air force 'top brass' had little choice but to agree to these new standards and officially endorse them by issuing a directive ordering the development and construction of the SDB strategic bomber.

After obtaining TsAGI approval for his concept Myasishchev addressed Mikhail V. Khrunichev, the then Minister of Aircraft Industry, and proposed to build such an aircraft. Khrunichev supported the idea and reported 'upstairs' to Stalin; so did V. M. Malyshev, the Vice-Chairman of the Soviet Union's Council of Ministers (CofM). Later, at a Kremlin confer-ence which effectively outlined the direction in which the Soviet Union's strategic aviation should develop, Stalin uttered a famous phrase: 'Let's believe Comrade Myasishchev and entrust him with developing such an aircraft.' Thus Myasishchev received *carte blanche* in recruiting specialists for his reborn OKB.

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A display model of the 'aircraft 95-1' – the first prototype of the Tu-95 strategic bomber powered by coupled 2TV-2F turboprops. The Tu-95 was unique in combining turboprops with swept wings.

The Boeing YB-52 Stratofortress (serial 49-241). This view shows well the B-52's huge wing area which gave it good altitude performance.

VX770, the Avro 698 Vulcan prototype. The simple cropped-delta wing planform changed to a compound delta on production aircraft.

The first prototype Vickers Valiant (Type 660, WB210). The Myasishchev M-4 was originally to have the same air intake design as the 'V-Bombers'.

Chapter 1

Shaping the Bomber

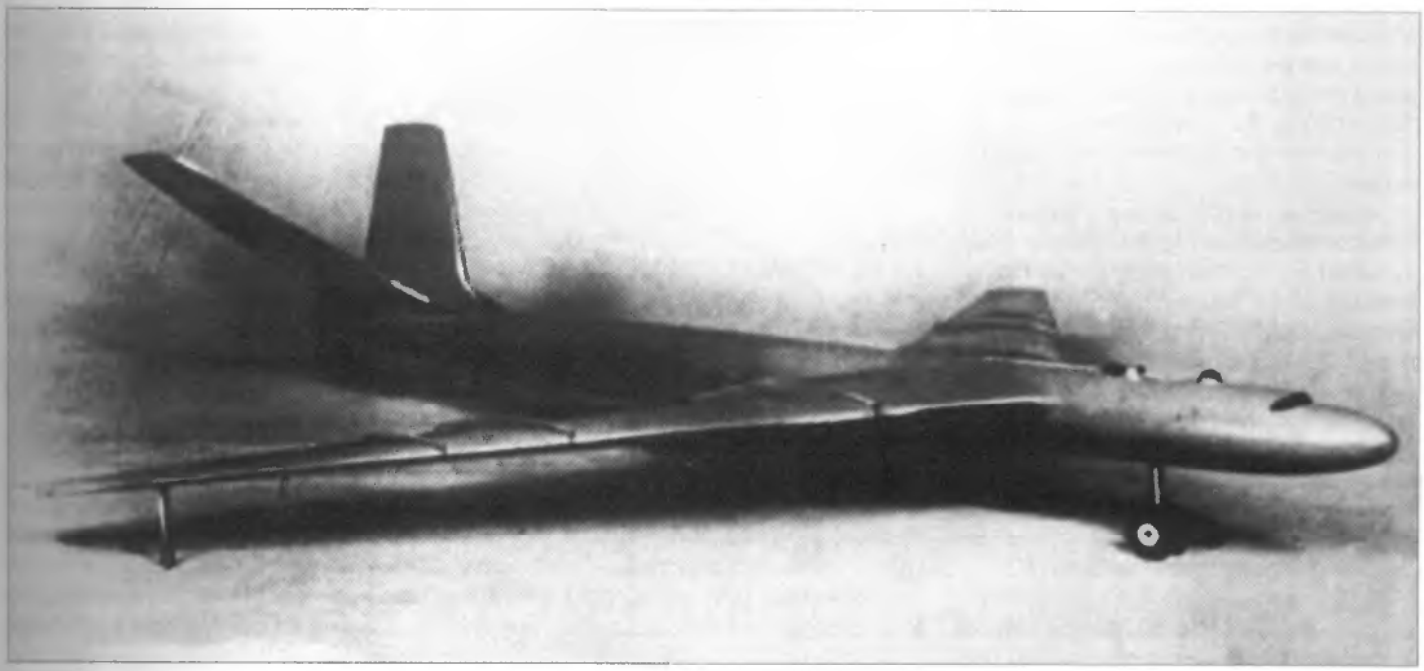
By early 1951 the choice of jet engines and swept wings for Myasishchev's new bomber had been virtually agreed. On 24th March 1951 the Council of Ministers issued directive No. 949-469 ordering the creation of GSOKB-23 (*Gosoo**dar**stvennoye so**yooz**noye **op**ytno-kon**strook**torskoye **byuro*** – State All-Union Experimental Design Bureau) and appointing Vladimir M. Myasishchev as its head. The same document assigned MAP plant No. 23 in Fili, then a western suburb of Moscow (now long since absorbed by the city), to the newly established OKB for experimental and production bomber construction. The 'All-Union' bit (meaning that the OKB had nationwide importance) spoke volumes for how seriously the government took the new bomber project.

CofM directive No. 949-469 stated that Myasishchev's reborn OKB was to specialise in long-range heavy bombers and what was referred to vaguely as *special mission aircraft*. (The latter kind turned out to be high-flying strategic reconnaissance aircraft, among other things.) The directive further tasked GSOKB-23 with developing a strategic bomber powered by either four Lyul'ka AL-5 axial-flow turbojets delivering 5,000 kgp (11,000 lb st) apiece or four 8,000-kgp (17,640-lb st) Mikulin AM-3 axial-flow turbojets. The aircraft was to be capable of covering a 12,000-km (7,450-mile) distance with a speed of 850-900 km/h (530-590 mph) and carrying a maximum ordnance load of 24 tons (52,910 lb) which would include bombs between 3,000 and 9,000 kg (6,613-19,840 lb). The first prototype was to enter flight test in December 1952, followed a year later by a second prototype featuring aerodynamic improvements.

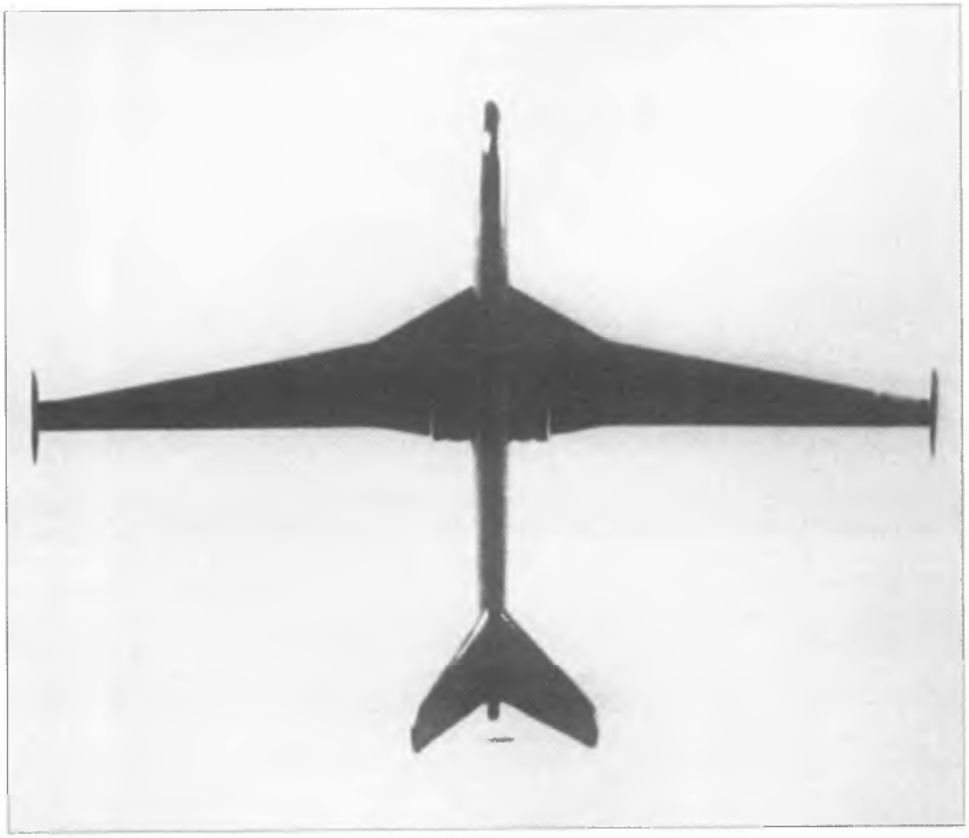
With this historic directive in place, work soon started on a plot of disused land between the Moskva River and the premises of plant No. 23 (nowadays the Scientific & Production Association named after Mikhail V. Khrunichev, an enterprise mostly concerned with ballistic missiles and space-launch vehicles) as the Myasishchev OKB recreated its research, development and experimental production facilities. An MAP order required existing aviation OKBs to transfer some of their engineers and other workers to the new OKB (subject to approval by Vladimir M. Myasishchev) – and, it should be noted, the order was obeyed without delay. Additionally, the OKB actively recruited a new cadre fresh from higher and technical education establishments; in particular, nearly all graduates of the Moscow Aviation Institute, class of 1951, were sent to OKB-23.

Not all in the ministry were happy with this rapid build-up. In October 1951 the then Minister of Aircraft Industry Mikhail V. Khrunichev wrote a report to Vice-Chairman of the CofM Nikolay A. Boolganin, stating: *'...the number of [the Myasishchev OKB's] engineering staff is currently 146 persons more than required by the CofM directive dated 18th May 1951. Deputy Chief Designer Comrade Glovatskiy's request to assign an additional 75-100 engineers to Comrade Myasishchev's OKB and increase the total number of employees to 400 is thus unfounded.'*

Apparently Myasishchev was well aware of Stalin's famous maxim, 'The personnel is the decisive factor', and he tried to get hold of as many skilled engineers and workers as he possibly could. The people that he, in the words of his close aide Leonid Leonidovich Selyakov, had set his sights on and whom he wanted to work for OKB-23 included aerodynamicist Matveyev of the Flight Research Institute, engineers Fel'sner and Baryshev of the Il'yushin OKB, engineer Leonid L. Kerber of the Tupolev OKB and the future academician Mikhail K. Yangel' from the NII-88



A display model of an early project configuration of the 'aircraft M' bomber featuring a butterfly tail, flush air intakes and an aft-retracting nose gear unit. Note also the apparently 'solid' nose lacking a glazed navigator's station.



Another PD configuration of the 'aircraft M' featuring a butterfly tail and unswept wings.

research institute. The Chief Designer had worked with all of them before and knew their worth, but not all of these people would eventually join the Myasishchev OKB.

By the end of April 1952 the Myasishchev OKB had virtually regained its former self – especially since, in accordance with the aforementioned MAP order, the designers and production engineers who had worked for the defunct OKB-482 were to be transferred to Myasishchev's new OKB by any means. Due to this and the 'infusion of fresh blood' the staff of the OKB and plant No. 23 totalled more than 4,000 by the time the design bureau's new premises and the factory were ready for action.

Initially a handful of designers had to shoulder the main burden of the task. These included Leonid L. Selyakov who drew the first sketches of the future 200-ton (440,900-lb) bomber. He was forced to be a jack-of-all-trades, being responsible both for general arrangement design, structural strength calculations, aerodynamic design and strategy development. Vladimir M. Myasishchev was busy with major organisational tasks at the time, forming the sections, departments and teams of the new enterprise. These are Selyakov's recollections of those days:

'My temporary "office" – the place I had to work in – was a tiny cubicle near the office of the plant's former vice-director which was (also temporarily) occupied by V. M. Myasishchev. All the furniture there was consisted of a small table, a chair and a drawing board. I was all by myself. I had to perform the duties of a designer, aerodynamicist, structural weight calculations engineer, structural strength engineer and strategist. The task was to portray the outlook of the new aircraft on paper – including its basic dimensions, weights and performance figures. I had to create the first general arrangement of the new aircraft. Afterwards the huge design team would come in, making such alterations as would be necessary. Huge battles would rage as the engineers would discuss the pros and cons of this or that design feature. Meanwhile, however, I had to decide everything myself, choosing the road which we would follow.'

Here is another excerpt from Selyakov's memoirs:

'Vladimir Mikhailovich spent days and nights (yes, nights!) solving immense organisational tasks. He was hugely assisted in this complicated and painstaking job by Gheorgiy Nikolayevich Nazarov (his first deputy) and Nikolay Matveyevich Glovatskiy. People kept coming and applying for jobs; they had to be hired and organised into sections, departments and teams. We needed rooms to put them all in, and there were none. As a temporary measure we put them up in the storage rooms of the assembly shop. Time kept slipping away; the team needed some work to do, and it was up to me to prepare the work for them.

'Make no mistake, the job was an extremely complex one. All we had was questions but no answers. What engine type should we use? How refined was the aircraft from an aerodynamic and structural weight standpoint? Within an unbelievably short time frame we created the general arrangement – or, to be precise, the general outlines from which to proceed. Concurrently we devised the project's technological philosophy, so to say. This was because the aircraft was huge by the standards of the day and required new standard sizes and thicknesses of metal stampings, sheets, forgings, etc. This crucial aspect was the responsibility of a remarkable person, Z. Nepomnyashchiy, the chief technologist of our new organisation. M. Leshchenko, the then Director of plant No. 23, played a major part in this and other matters.

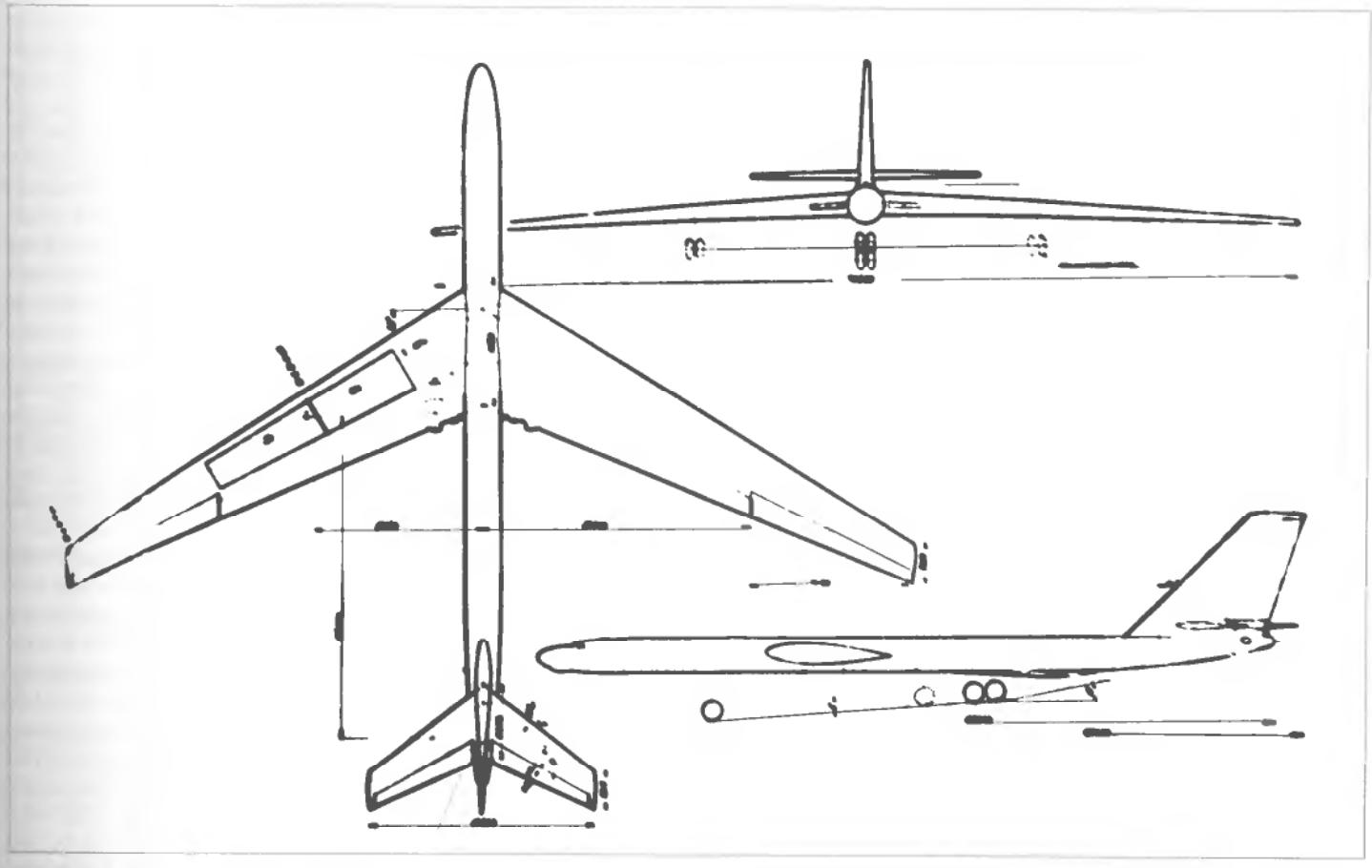
'As the organisation grew, the scale of the work widened. For the first six months, however, the entire plant was mostly concerned with manufacturing a tremendous number of wind tunnel and scaled-strength models which were necessary for project development.'

According to the general operational requirement (GOR) endorsed by the Soviet Air Force Commander-in-Chief on 23rd June 1951, the new bomber, which would have a crew of eight, was to have a 12,000-km (7,450-mile) range with a 5-ton (11,020-lb) bomb load. The aircraft was required to fly over the target at 11,000 m (36,090 ft) with a speed of Mach 0.75. This altitude, which was some 4,000 m (13,120 ft) lower than that of the Boeing B-52 Stratofortress and only a little higher than that of the B-29, was determined by the Soviet bomber's smaller wing area (350 m²/3,760 sq. ft) and powerplant performance. The maximum ordnance load was specified as 24 tons (52,910 lb).

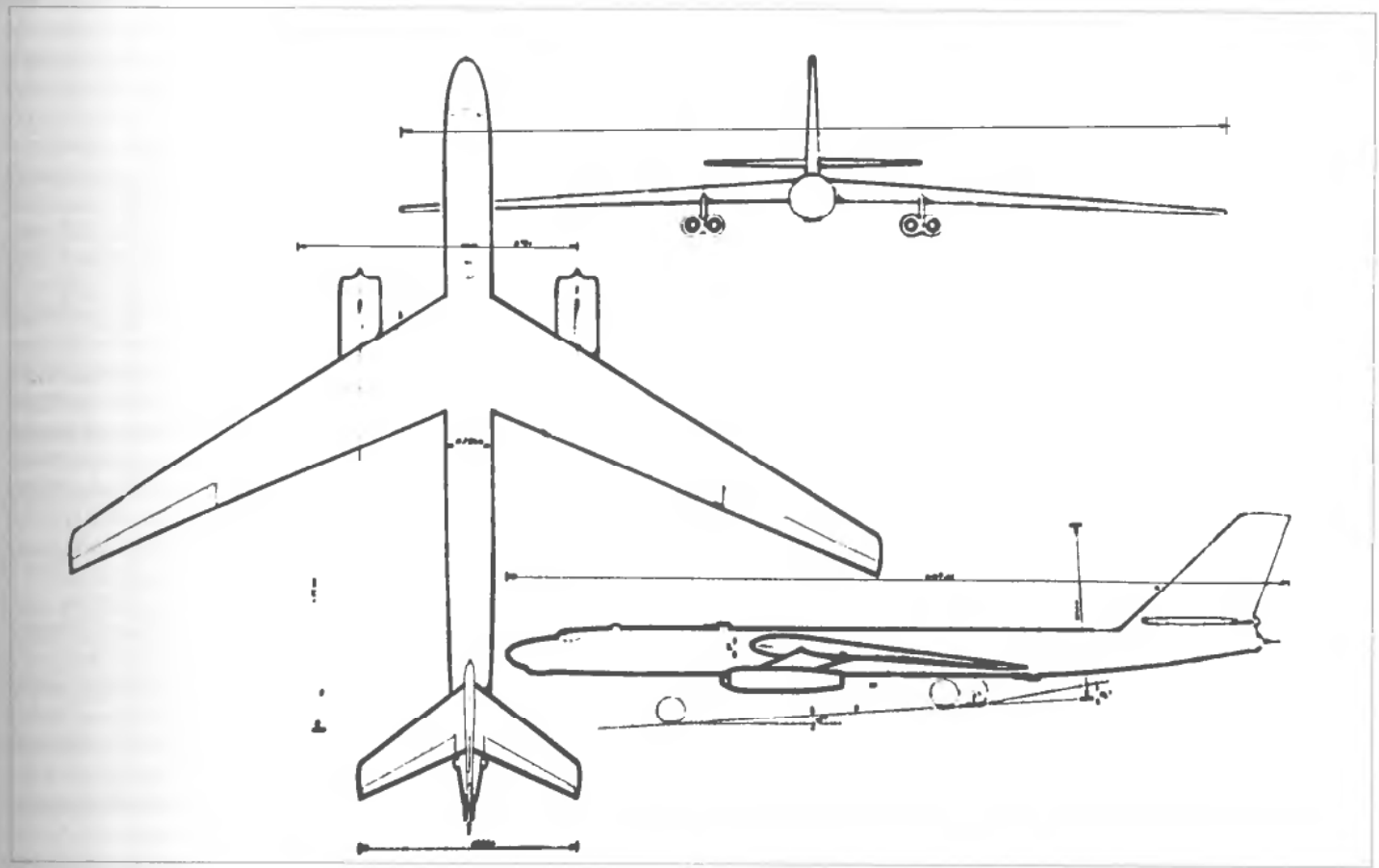
The success achieved by MiG-15 fighters in combat against slow and ill-armed B-29s in the Korean War was given due regard by the Soviet military, which demanded that Myasishchev's bomber should have potent defensive armament. This was to comprise four twin-cannon barbettes (two dorsal barbettes, a ventral barbette and a tail barbette).

Quite a lot of PD studies was considered for the new jet bomber which bore the in-house designation *izdeliye* M. (*Izdeliye* (product) such-and-such is a term often used for coding Soviet/Russian military hardware items.) These differed in a number of important respects, but what they had in common was the bomber's large size, high aspect ratio wings and bicycle landing gear arrangement (more about this later). Here are but a few of these preliminary configurations (the enumeration given is for the sake of convenience only and does not reflect the order in which they actually appeared).

Version 1 had unswept wings and a butterfly tail, looking like a scaled-up competition



Above: An OKB-23 diagram showing one of the new bomber's project configurations with buried engines and 'V-Bomber' style common intakes. The outrigger struts are placed well inboard and equipped with large-diameter twin wheels; note also the wing fuel cell bay placement.



A three-view of another project configuration of 'aircraft M' featuring B-47 style paired nacelles on sharply swept pylons. The large-span ailerons are noteworthy.

sailplane. The wing leading edge was kinked, featuring about 30° sweep at the root and very slight sweep over the rest of the span; the trailing edge was at right angles to the fuselage. The engines were buried in the wing roots, the engine cowlings protruding above the wing upper surface at the trailing edge, just like on the real M-4. The wingtips mounted the outrigger gear fairings which protruded halfway beyond the wing leading edge.

Version 2 likewise had a butterfly tail but featured swept wings. Again the four engines were buried in the wing roots. The landing gear included a twin-wheel nose unit and a four-wheel main bogie; the outrigger struts and their fairings were moved slightly inboard from the wingtips. The defensive armament was reduced to three turrets, the upper turret being placed ahead of the wings and the lower one aft of the main gear unit.

Version 3 featured conventional swept tail surfaces. The wing thickness at the roots amounted to nearly 70% of the fuselage diameter. As in Version 2, the aircraft had a twin-wheel nose unit and a four-wheel main bogie, but this time the outrigger struts were mounted at the wingtips and augmented by two auxiliary struts at 40% span which were jettisoned after take-off; the outrigger struts had no fairings. The defensive armament was identical to Version 2; the fuel tanks were placed in the wings and fuselage.

Version 4 again had a conventional tail unit but the wings were nearly shoulder-mounted and the engines were carried in Boeing B-47 style paired pods on swept pylons located at approximately 25% span. The wing planform and fuselage design were very similar to that of the future M-4, except for the twin-wheel nose gear unit and the defensive armament arrangement which was identical to Versions 2 and 3.

Version 5 differed radically in that it was a turboprop aircraft. Eight Kuznetsov TV-2F engines, each rated at 6,250 ehp and driving eight-bladed contra-rotating propellers, were installed back to back in nacelles going clean through the wing torsion box (ie, the forward engine in each pair was in tractor configuration while the aft engine was in pusher configuration). The aircraft was 50.5 m (165 ft 8⅛ in) long and 12.1 m (39 ft 8⅝ in) high, with a wing span of 51.54 m (169 ft 1 in); wing area was 304 m² (3,270 sq. ft) and the MTOW was 175 tons (385,800 lb).

Version 6 was a swept-wing aircraft powered by six Lyul'ka AL-5 turbojets; four engines were buried in the wing roots, breathing through elliptical intakes (as on the future M-4), while two were mounted in underwing nacelles further outboard. The overall dimensions and wing area were identical to Version 5 and the MTOW was increased to 178 tons (392,420 lb).

Version 7 was almost identical to the previous one but powered by four Mikulin AMRD-03 turbojets buried in the wings; the MTOW was 177 tons (390,210 lb).

Version 8 was very similar but with slightly different dimensions. The aircraft was 50.6 m (166 ft) long and 11.7 m (38 ft 4⅝ in) high, with a wing span of 46.3 m (151 ft 10⅞ in); wing area was 280 m² (3,010 sq. ft) and the MTOW was 186 tons (410,050 lb).

Other versions were also considered. One was a much larger aircraft with a 65-m (213 ft 3 in) overall length, a 76.2-m (250-ft) wing span, a 19.85-m (65 ft 1½ in) stabiliser span and a 3.2-m (10 ft 6 in) fuselage diameter; the wings and horizontal tail were swept back 30° at quarter-chord, while vertical tail sweep was 40°. Yet another version was 40.5 m (132 ft 10½ in) long, with a 51-m (167 ft 3⅞ in) wing span, a 13.3-m (43 ft 7⅝ in) stabiliser span and a 2.9-m (9 ft 6⅛ in) fuselage diameter; the engines were carried on pylons positioned 6.76 m (22 ft 2⅛ in) from the fuselage sides.

Powerplants under consideration included the Mikulin AM-3-200 turbojet, the AM-13 coupled turbojet consisting of two 4,100-kgp (9,040-lb st) AM-11s, the 6,830-kgp (15,060-lb st) Lyul'ka AL-7 turbojet and the mighty Kuznetsov TV-12 (NK-12) turboprop rated at 12,500 ehp and driving eight-bladed contra-props. Upon careful consideration the engineers chose a swept-wing aircraft with a conventional swept tail unit powered by four AM-3s, the most powerful Soviet jet engines of the time. Using AL-5s did not allow the aircraft to meet the government specifications, especially as regards field performance – the take-off run was estimated as an absolutely unacceptable 3,500 m (11,490 ft).

Izdeliye M was packed with new features – the huge swept wings of high aspect ratio, the large fuselage accommodating the crew, remote-controlled cannon barbettes, capacious bomb bay, the swept tail surfaces and, of course, the landing gear, the likes of which had not been seen on heavy bombers before. The engineers were facing the daunting task of obtaining a high lift/drag ratio coupled with a high speed, low specific fuel consumption (SFC) and low structural weight. The correlation and mutual effect of the future aircraft's various properties had still to be determined. For instance, for the first time it was established that the influence of wing aspect ratio on structural weight and L/D ratio depended on wing loading; ie, it transpired that it was only possible to create a lightweight high aspect ratio structure if the wing loading was fairly high. A sufficiently high fuel load/structural weight ratio could only be achieved with a high wing loading.

To alleviate the bending loads on high aspect ratio wings the Boeing Military Aircraft Company had opted for underwing engine nacelles spread out spanwise when developing the B-47 and B-52. This arrangement gave a bonus, facilitating engine maintenance and change; however, it also created major problems – the problems of ensuring dynamic wing stability as the wing/nacelle assembly flexed in flight and of combating the aerodynamic interference between the wings and the nacelles. (Later on, the underwing engine placement became the most common as progress in aerodynamics and structural design theory eliminated these problems.)

Conversely, the Old World preferred the buried engine placement. Avro, Handley Page and Vickers chose it for their 'V-Bombers'. TsAGI also favoured this arrangement, as evidenced by a whole series of PD projects of the 'aircraft 88' twinjet medium bomber developed by the Tupolev OKB (it emerged in 1952 as the Tu-16/NATO reporting name *Badger*). However, as distinct from the 'V-Bombers' and the Tu-16, on the *Izdeliye* M the Myasishchev OKB decided to house the engines completely inside the thick wing root section. By thickening this part of the wing the engineers managed to make it stiffer, which confined aeroelasticity and dynamic wing stability problems to the outer portions of the wings. This made it possible to design a relatively lightweight wing structure with a high resistance to flutter and turbulence. (Speaking of which, the same design philosophy of rigid inner wing portions and flexible outer wings was later used by the Boeing Commercial Aircraft Group for the Boeing 737 short-haul airliner.)

The thick inner wings also allowed the engines to be optimally placed with respect to each other. Unlike the Tu-16, the engines were not 'squeezed' into the sides of the area-ruled fuselage but separated from it. Each engine had its individual air intake protruding beyond the wing leading edge (the Vulcan/Victor/Valiant-style paired intakes flush with the leading edge were considered at an early design stage but then discarded). The intakes were stepped to minimise pressure losses in the inlet ducts and preclude harmful interference in all engine operation modes. (By comparison, the Mikoyan/Gurevich MiG-19 *Farmer* tactical fighter, which had a common pitot air intake divided by a splitter into air ducts for the two engines, sometimes encountered problems. In a crosswind the downwind engine had to be started first, otherwise the upwind engine would literally rob it of breath, making start-up impossible!) The engine jetpipes were angled 4° outwards and 4° downwards to avoid the exhaust impinging on the rear fuselage sides and horizontal tail, which might cause fatigue problems.

In addition to theoretical wing design work, OKB-23 engineers undertook a lot of

research on wing dynamics and flutter, using scaled-strength models. It turned out that the deep and voluminous root sections of the high aspect ratio wings sort of reduced the computed wing span, increasing the wings' flexural and torsional stiffness.

Summing up, it may be said that, while the TOW of the projected *izdeliye* M was similar to that of the B-52, its wing area was about 150 m² (1,610 sq. ft) less, resulting in an exceptionally high wing loading – about 600 kg/m² (123 lb/sq. ft). By comparison, the B-52's larger span and wing area gave a wing loading of about 425 kg/m² (87 lb/sq. ft). This efficient wing structure, together with an optimum fuselage diameter of 3.5 m (11 ft 5¾ in), assured the Myasishchev bomber a relatively low structural weight.

The new bomber's landing gear design was of special interest. A major contribution to its development was made by landing gear section chief G. I. Arkhangel'skiy, structural strength department chief L. I. Balabookh and two talented young engineers, V. K. Karrask and G. D. Dermichev. In their quest for the optimum landing gear arrangement for a 200-ton aircraft the engineers considered the relative merits of the classic tricycle layout, a 'quadruped' multi-unit layout patterned on the B-52 and the bicycle layout. A special theoretical research group was set up to investigate the 'dynamics of a heavy aircraft's travel on a runway'. Eventually the team selected a bicycle landing gear with a special tilting nose gear bogie; this feature served the same purpose as the 'jump strut' of carrier-based aircraft, increasing the angle of attack during the take-off run to achieve extra lift. The chosen layout provided for maximum stability during the take-off/landing run and enabled automatic take-off of a heavy aircraft within the specified runway length.

The bicycle landing gear so boldly proposed by Myasishchev was not exactly *terra incognita* to Soviet aircraft engineers by then. Aside from Robert L. Bartini's pre-war El and Stal'-8 fighter prototypes which featured a retractable monowheel supplemented by a tailskid and outrigger skids, the first Soviet aircraft to have a bicycle undercarriage dated back to 1941 when Igor' V. Chetverikov proposed his I-1AM-37 fighter.

The next attempt was undertaken in 1949 when TsAGI wanted to convert a Tupolev UTB bomber trainer (*oo**cheb**no-treni**rov**ochnyy bombardi**rov**schchik*) into a bicycle landing gear testbed for accumulating research data to be used in the development of other aircraft. (The UTB was a dual-control derivative of the World War Two-vintage Tu-2 medium bomber powered by 575-hp Shvetsov ASh-21 seven-cylinder radials driving two-blade propellers instead of 1,850-hp ASh-82FN 14-cylinder radials with three- or four-blade props.) The work proceeded under the direction of I. P. Tolstykh. The modified UTB was to have a special truss mounted under the fuselage to permit installation of experimental landing gear struts at various distances from the CG, thus allowing the optimum position and incline of the main gear units of future aircraft to be determined. The work was commissioned by OKB-1, a design bureau based at plant No. 256 in Doobna near Moscow where captive German engineers had been at work since early 1947. OKB-1 was then developing the 'aircraft 150' twinjet medium bomber, an unsuccessful competitor to the Tu-16 featuring a bicycle undercarriage; the work was supervised by Semyon M. Alekseyev (the former aide of fighter designer Semyon A. Lavochkin) who had been appointed head of the 'captive German' OKBs in 1948 and OKB-1's chief designer for jet bombers in 1949.

Eventually the modified UTB was never built, even though Vladimir M. Myasishchev and Gheorgiy N. Nazarov (both MAI employees at the time) were asked to participate in the development of the testbed at TsAGI's request. To speed up verification of the bicycle landing gear on a real-life combat aircraft Alekseyev offered to convert his I-215 twinjet multi-role fighter whose take-off weight was similar to that of the UTB. This obviated the need to design and build a specialised aircraft for this mission. The I-215 existed and was flyable; all the engineers needed to do was install a twin-wheel main gear strut (with larger wheels than hitherto) under the centre fuselage and small outrigger struts beneath the engine nacelles, thus eliminating the existing mainwheel wells in the wings.

It was decided to complete the second prototype I-215, which was languishing at the Gor'kiy aircraft factory No. 21 after the liquidation of Alekseyev's OKB-21 in 1948, with a bicycle landing gear. Bearing the designation I-215D (*doob**lyor***), it differed considerably from the first prototype. (*Dooblyor* – lit. 'understudy' – was the Russian term for 'second prototype' and was used until the late 1960s.) The new main gear unit was placed aft of the aircraft's CG and incorporated a 'kneeling' feature to increase the AOA on take-off by 3°. The wings had an incidence of 3° 30'; this, together with the 'kneeling' feature, provided an adequate AOA and sufficient lift for take-off. Hence, unlike aircraft with a conventional tricycle landing gear, the I-215D could become airborne without rotation, not requiring the pilot to haul back on the control stick. Thus, take-off was virtually automatic; all the pilot had to do was keep the aircraft from sideslipping and monitor engine operation at maximum power.

Test pilot I. Ye. Fyodorov, Hero of the Soviet Union, flew the I-215D to the OKB-1 flight test facility in Doobna and the flight went perfectly, the aircraft behaving as if it had been designed as a 'bicycle' from the outset. The tests were so successful that several other design bureaux were able to develop viable combat aircraft with a bicycle landing gear. As for the original 'customer', OKB-1 scaled up the I-215D's landing gear design and used it on the 'aircraft 150' which was ten times heavier. This both proved the feasibility of using a bicycle undercarriage on a large aircraft and verified the means of reducing the take-off run and simplifying the take-off procedure as compared to aircraft with a conventional tricycle landing gear.

Obtaining MAP permission, Myasishchev and Nazarov carefully studied the know-how OKB-1 had accumulated; to this end Nazarov was seconded to plant No. 256, participating in the trials of 'aircraft 150' as a back-up for the engineer in charge. This experience came in most handy when designing the *izdeliye* M jet bomber.

Careful analysis of the results obtained with the I-215D and 'aircraft 150' showed that the 'kneeling' feature was unusable for an aircraft having thrice the take-off weight of the 'aircraft 150' due to runway loading restrictions. However, there is a saying: if the mountain will not come to the Prophet Mohammed, then Mohammed will go to the mountain. Using the experience gained by OKB-1, the Myasishchev OKB 'reversed' the idea: since the main gear could not 'kneel', the nose gear would 'stand on tip-toe' to achieve the desired result. Thus the massive 12-wheel landing gear of the Myasishchev bomber created the same effect as the delicate gear of the I-215D single-seat fighter.

In addition to the advantages described above, Vladimir M. Myasishchev pointed out as early as the SDB project's PD stage that the bicycle undercarriage offered a substantial weight saving and thus was the best choice for the new bomber. Such a landing gear accounted for no more than 3-3.5% of the aircraft's weight versus 4-6.5% for a conventional tricycle landing gear. This was because a bicycle undercarriage retracted into the fuselage, not into the high-set wings (it should be noted that shoulder-mounted wings are the best choice for a bomber, since they maximise usable fuselage volume); thus the main gear units could be made shorter and consequently more lightweight. Besides, a bicycle landing gear obviated the need for all manner of gear fairings on the wings which created extra drag; most importantly, however, it saved the wing structure from shock loads ('bumps') during taxying, take-off and especially landing.

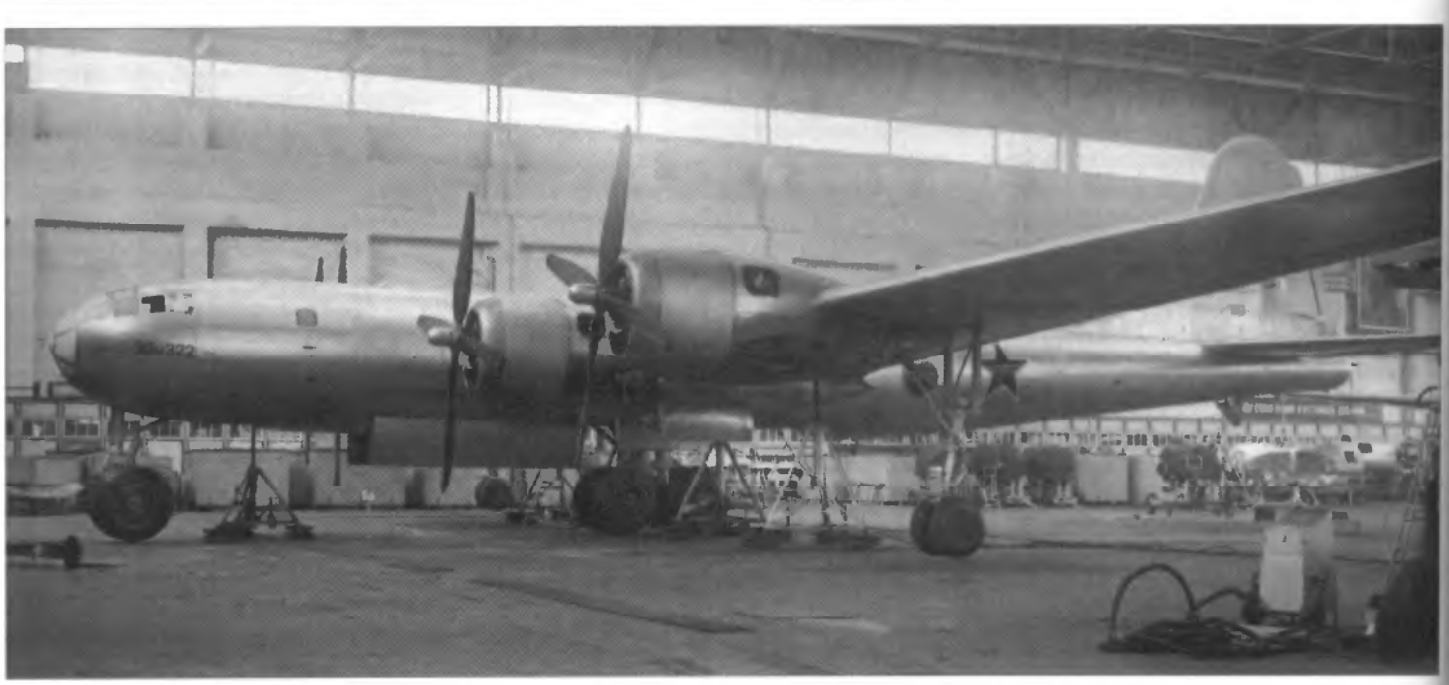
Compared to other landing gear arrangements the bicycle landing gear was better suited for operation from unpaved airstrips,

which might be a necessity even for heavy bombers in wartime conditions. Finally, the bicycle landing gear made it possible to place the bomb bay close to the CG, distributing the fuel tanks, equipment, etc. almost 50/50 within and outside the wheelbase.

In order to test a bicycle landing gear that would be similar in size and weight to that of the real thing, OKB-23 developed a special version of the Tu-4 bomber. In late 1951 a brand-new *Bull* manufactured by plant No. 23 (no serial, construction number 230322) was delivered to the OKB for conversion. Completed in January 1952, this testbed bore the in-house designation *izdeliye* ShR (or ShR-1), the Sh denoting *shassee* (landing gear) and the R referring to the Tu-4's product code (*izdeliye* R). The standard nose gear unit with 950 x 350 mm (37.40 x 13.77 in) wheels gave way to a new twin-wheel levered suspension strut with 1,450 x 520 mm (57 x 20.4 in) wheels. The scratchbuilt main gear unit was a pair of stock Tu-4 main gear oleos mounted in tandem and rigidly connected; to these was hinged a four-wheel bogie with 1,450 x 520 mm wheels. The entire assembly was attached to a hefty tubular truss installed near the aft bomb bay; the main gear could be fitted in three different ways to absorb 72%, 85% or 90% of the total weight. This unusual feature

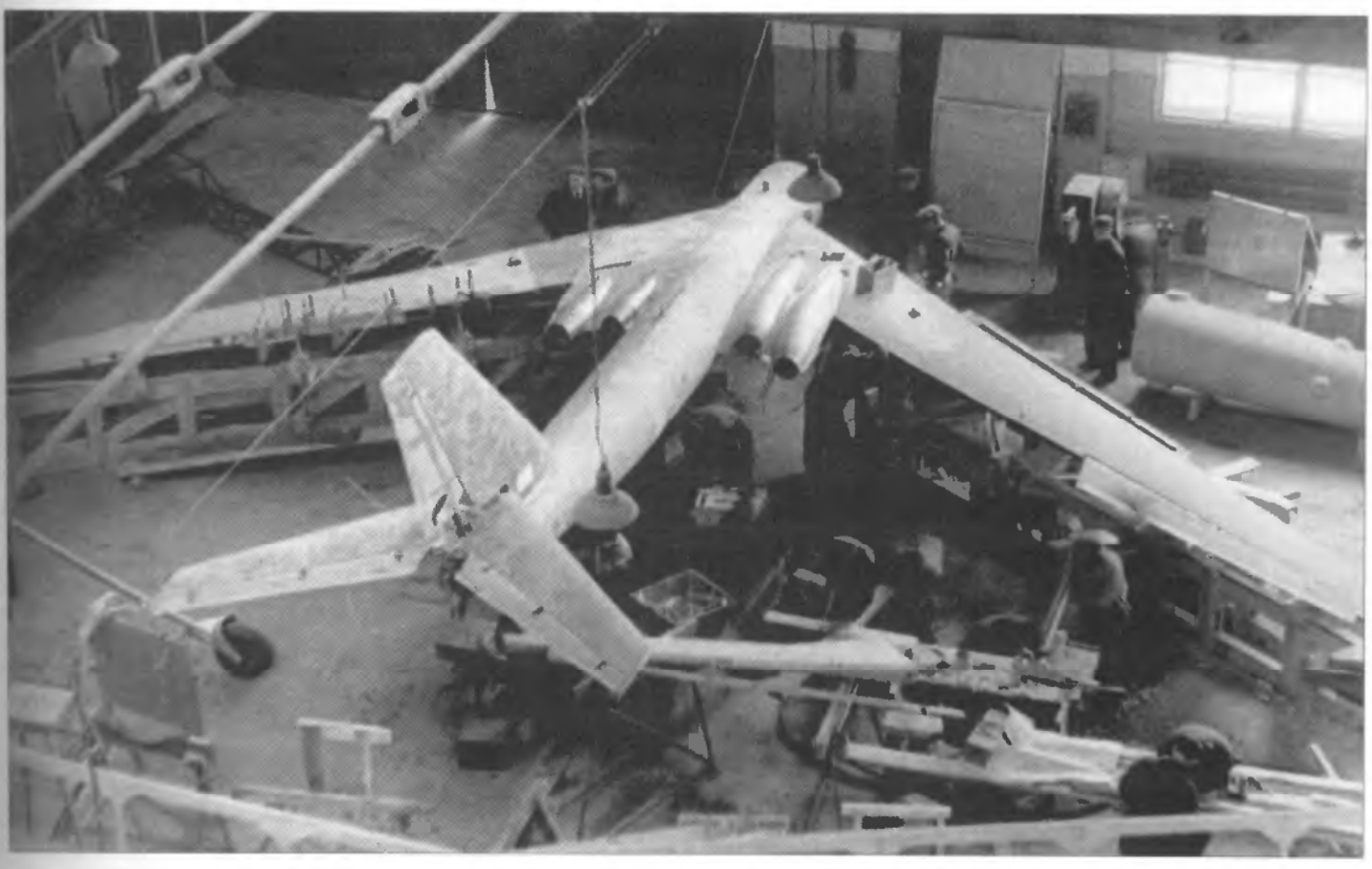
Left: Several modified Tu-4 bombers were used by OKB-23 to verify the new features of the future M-4. One of them (c/n 230322) was the ShR designed for testing the bicycle landing gear. This is a close-up of the ShR's experimental main gear bogie and twin shock absorbers.

Below: This view of the ShR in early ShR-1 configuration shows the large nosewheels and adjustable outrigger struts of the non-retractable experimental gear, and makes an interesting comparison with the photo on page 4.

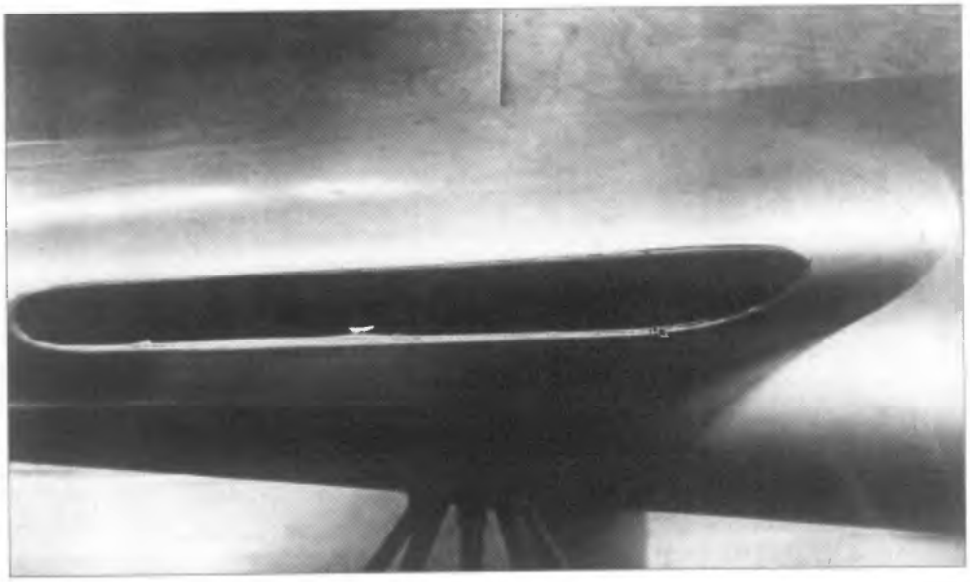


Above: The full-scale mock-up of 'aircraft M' in the OKB's experimental shop. This view illustrates the extensively glazed navigator's station (the shape of the glazing differed slightly from that of production aircraft), the lateral observation/sighting blisters and the flush intakes, as well as the sheer size of the bomber.

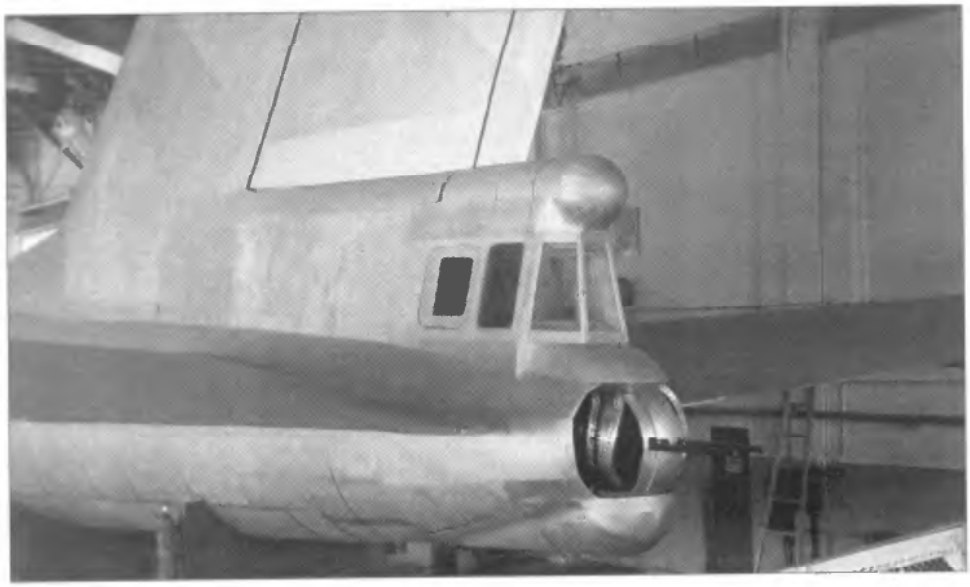
Below: This large-scale model with movable control surfaces was tested in TsAGI's largest wind tunnel, the T-101.



Above: Close-up of the flightdeck glazing. Note that the flightdeck roof was raised to provide enough headroom. The dorsal blister was used both for navigation and gun-aiming.



Above: Close-up of the common air intake serving the two starboard engines.



The rear fuselage of the 'aircraft M' mock-up, showing the tail gunner's station with bulletproof rear glass panes, the twin-cannon tail turret and the gun ranging radar in a hemispherical radome. Note the low-set horizontal tail which would be moved up on the actual aircraft.

was intended to see how the changing weight distribution and wheelbase affected the aircraft's field performance and ground manoeuvrability (this was because different versions of the jet bomber's PD project featured an aft-retracting or forward-retracting nose gear unit, with attendant changes in wheelbase and weight distribution). The nosewheels and mainwheels were equipped with hydraulic brakes.

The outrigger struts installed a short distance outboard of the Nos. 1 and 4 engines consisted of stock Tu-4 nose gear units mated with special truss-type mountings which allowed the length of the outriggers to be adjusted. Interestingly, the non-retractable experimental landing gear could be removed and the normal gear reinstalled for positioning flights.

The test programme was conducted by the Flight Research Institute named after Mikhail M. Gromov (LII – ***Lyot****no-is****sled****ovatel'skiy insti****toot***). Stage 1 lasted from April to June 1952; the ShR-1 made 50 taxying runs and 34 flights to check stability and handling, the operation of the nose gear steering mechanism and the optimum position of the main and outrigger struts.

Later the twin nosewheels were rejected in favour of a four-wheel bogie with electrically steerable nosewheels. Hence the Tu-4 testbed was modified accordingly and redesignated ShR-2. In this guise the aircraft underwent further tests in 1953, making 24 taxying runs and 17 flights; the nose gear bogie absorbed 20% of the weight versus 40% on the real thing. The tests fully confirmed the anticipated behaviour and allowed the take-off and landing technique to be mastered long before *izdeliye* M actually flew. LII test pilots who flew the ShR testbed rated the bicycle landing gear very highly.

Even before the ShR was built the Myasishchev OKB manufactured an electrically controlled scale model of the four-wheel nose gear unit which served to test the bogie tilting system. This was followed by a special simulator in which pilots perfected the jet bomber's automatic take-off procedure. The simulator helped many pilots overcome the psychological barrier associated with flying bicycle-gear aircraft – it was hard not to haul back on the control yoke in order to initiate rotation on take-off, which is standard operational procedure on aircraft with a conventional tricycle undercarriage.

The nose gear deserves special attention for yet another reason – its unusual steering system. For all practical purposes the *izdeliye* M bomber behaved like a tractor-trailer combination (a 'big rig') while taxying – the forward pair of wheels on the nose gear bogie was steerable, the bogie itself turning on the axis of the shock absorber strut. Thus when

the wheels were turned the bogie behaved like a motor car, the rest of the aircraft tagging along like a semitrailer. When the nose gear bogie was tilted to induce rotation on take-off, the steering mechanism was disabled automatically. The result was a simple but effective system which gave the bomber high manoeuvrability on the ground.

Several other testbeds based on the Tu-4 were involved in the development of *izdeliye* M. For the first time in Soviet aircraft design practice the aircraft incorporated fully powered controls with reversible and irreversible hydraulic actuators in the aileron, rudder and elevator control circuits, plus an artificial feel mechanism. Testing these features on a ground rig was not enough and the actuators had to be verified in flight. Hence the Myasishchev OKB converted another Tu-4 (identity unknown) into the *izdeliye* UR control system testbed; the U stood for [*sis**tema***] *oopravleniya* (control system) and the R was again a reference to the Tu-4.

The first version, designated UR-1 featured reversible actuators everywhere; tests in this configuration were completed in March 1952, involving 12 flights totalling about 20 hours. The tests showed that the powered controls worked acceptably, even though a few failures did occur. Later the aircraft was refitted with irreversible actuators and tested in April 1952 as the UR-2. Further tests with a pneumatically-operated automatic artificial feel system were conducted on the UR-2 in September 1952.

Later on, the UR-2 was modified for testing the crew escape system of *izdeliye* M and redesignated *izdeliye* KR, the K denoting *katapool'**tee**ruyemoye **kres**lo* (ejection seat). This was necessitated by the bomber's unusual escape system with movable ejection seats designed in-house, the captain, co-pilot and navigator/bomb-aimer ejecting consecutively through a common hatch.

The KR featured ejection seats for the pilots, navigator, flight engineer and dorsal gunner. Between October 1952 and January 1953 it performed 12 test flights involving 20 ejections, including seven with live ejectees. As a result, some changes were introduced into the ejection seat's design.

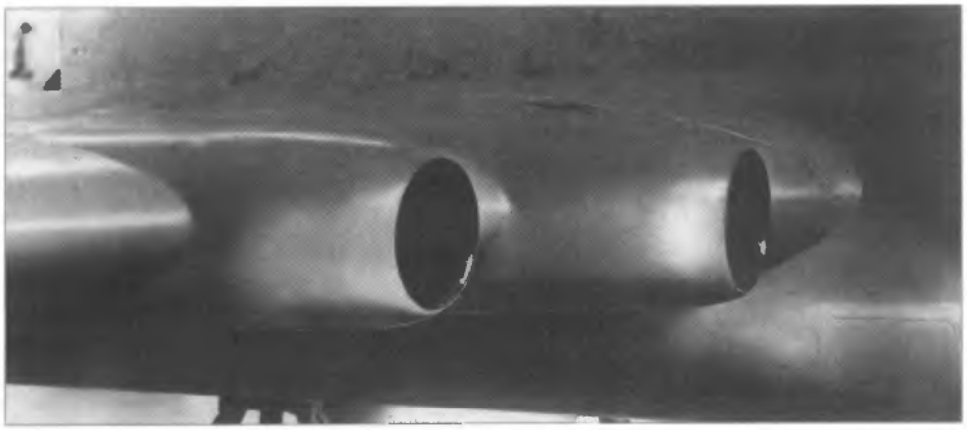
Finally, the Myasishchev OKB together with LII converted another Moscow-built Tu-4 (no serial, c/n 230113) into one of the institute's seven Tu-4LL (*le**tay**uschchaya labora**to**riya* – lit. 'flying laboratory') engine testbeds. (Note: In Russian the term *letayuschchaya laboratoriya* is used indiscriminately to denote any kind of testbed or research aircraft.)

The first configuration of this particular aircraft, known in the Myasishchev OKB as *izdeliye* DR-1 (D stood for ***dvig**atel'* – engine), served to test the Lyul'ka AL-5 turbojet which was then considered as a possible power-

Above: The captain's instrument panel on the 'aircraft M' mock-up. The panel in the centre is for the engine instruments.

Above: The co-pilot's control column and instrument panel. Note that the aileron control wheel is of a different shape than on the port side; the optimum shape had yet to be determined.

The radio operator/gunner's station, showing the KPS-48 gunsight which could be swung out of the way. Note that the lateral blisters were perfectly round on the mock-up – another feature that would change.



Above: The common flush air intakes were soon discarded in favour of individual elliptical intakes protruding beyond the wing leading edge in a stepped arrangement.

plant for the new bomber. In January 1952, when the much more powerful Mikulin AM-3 was selected, this replaced the AL-5 development engine on Tu-4LL c/n 230113 and the in-house designation at OKB-23 was changed to DR-2.

The turbojet was installed in the forward bomb bay in a special nacelle which could move up and down on a system of levers. It was semi-recessed in the fuselage for take-off and landing to give adequate ground clearance, extending into the slipstream before start-up; it was also possible to extend the engine for ground runs when the aircraft was parked over a special trench with concrete-lined walls and a jet blast deflector. When the nacelle was retracted the air intake was closed by a movable shutter to prevent windmilling and foreign object damage. In an emergency (for instance, if the hydraulic retraction mechanism failed) the development engine could be jettisoned to permit a safe landing, special pyrotechnical guillotines cutting the fuel and electric lines. The test engineer and his assistant sat in the No. 2 pressure cabin just aft of the wings; the cabin floor incorporated a window for inspecting the nozzle of the development engine.

The definitive version of the advanced development project (ADP) featuring four 8,700-kgp (19,180-lb st) AM-3s was completed in August 1951; Soviet Air Force C-in-C Col. Gen. Pavel F. Zhigarev endorsed the ADP documents on 19th September. The conclusive report on the ADP of the *izdeliye* M long-range fast bomber stated that, while the bomber's speed, armament and equipment met the specifications set forth in Council of Ministers directive No. 949-469, the range and service ceiling were insufficient and the take-off run was excessively long. The same document approved the choice of the AM-3 turbojet as the bomber's powerplant and recommended that the engine be further improved.

A full-scale wooden engineering mock-up was built for finalising the bomber's internal layout and the positioning of specific equipment items; this inherited the provisional designation SDB of the very first project studies. The layout basically followed the one set forth in the ADP documents. Outwardly the mock-up differed from the subsequent first prototype in having flush engine air intakes. The SDB was presented to the mock-up review commission on 22nd October 1951; on 30th November the commission gave its general approval, signing a protocol which said the mock-up could serve as a basis for the prototype's manufacturing drawings.

Concurrently the OKB built the SM propulsion test rig (*stend motornyy*) which represented a wing section with two engines, a fuel system, etc. Another ground test rig called BV ([*stend*] ***bom**bovovo vo'oroo**zheni**ya*) was used to check bomb loading options; it represented a centre fuselage section with the bomb bay, complete with bomb racks. Thus by the end of 1951, OKB-23 had virtually completed development of its first jet strategic bomber. Next, the OKB started issuing manufacturing drawings for the first prototype; construction of the first prototype began in early 1952.

Numerous research and development organisations in the industry were actively involved in the creation of the new bomber; these included TsAGI, LII, the Central Aero Engine Research Institute (TsIAM – *Tsen**trahl'**nyy insti**toot** aviatsi**on**novo mo**tor**ostro**yeni**ya*) and the All-Union Research Institute of Aviation Materials (VIAM – *Vseso**yooz**nyy insti**toot** aviatsi**on**nykh mate**riahl**ov*), to name but a few. Among other things, a whole team of VIAM experts was seconded to plant No. 23 to help with the issue of whether magnesium alloys should be used in the bomber's construction.

As work on the *izdeliye* M bomber progressed the team headed by Vladimir M. Myasishchev developed into a fully-fledged enterprise numbering 700 employees and capable of developing virtually any kind of aircraft. Within a short time the former technical draft section of plant No. 23 became an independent entity called OKB-23. This consisted of five sections: the Aerodynamics, Stability and Control Department (including the wind tunnel model section) headed by I. Ye. Baslavskiy; the Static Strength, Dynamic Strength and Aeroelasticity Department (including the scaled-strength model section) headed by L. I. Balabookh; the Design Department (including the Advanced Development Project Section) headed by S. A. Sidorov; the Information Department and technical library headed by N. I. Biryukov; and, finally, the aerodynamics laboratory. The mock-up construction section, the scale model section and the static test laboratory were the domain of the Design Department.

According to the late Leonid L. Selyakov the information department headed by engineer N. I. Biryukov played a major part in making the OKB what it was. Correctly processing and arranging information and presenting it in timely fashion to every designer was an issue taken very seriously in the Myasishchev OKB. All organisational issues were handled by Selyakov's aide A. D. Moorav'yov.

The SM propulsion test rig built for the 'aircraft M', comprising an inner wing section with fuel tankage and two engines (with the definitive intake design).

Chapter 2

The Bomber Flies

Prototypes and Testing

The specific operational requirement (SOR) for the *izdeliye* M bomber was endorsed by the Soviet Air Force C-in-C on 23rd June 1951 and by the mock-up review commission on 30th November 1951. That same month, when preparation of the manufacturing drawings was still in progress, the Myasishchev OKB's experimental shop set about manufacturing airframe sub-assemblies for two prototypes (c/ns 0001 and 4300003) and a static test article (c/n 0002). The complete set of manufacturing drawings was delivered by 1st April 1952, by which time the work was well advanced; final assembly of the first prototype commenced on 15th May that year. At factory No. 23 the aircraft received the product code *izdeliye* 25, whereas some Myasishchev OKB documents referred to the bomber as the 2M or VM-25 (ie, Vladimir Myasishchev, Project 25). The Air Force, however, allocated the service designation M-4 by which the bomber would be best known. Incidentally, ***tema dva**dtsat' pyat'* (Subject 25) was also the general designation of the strategic jet bomber programme which was desig nated as a top-priority programme for the other MAP and defence industry enterprises involved.

New production technologies were introduced as the M-4 programme gathered pace. For instance, to cut structural weight by reducing the number of skin panel joints the engineers decided to use duralumin sheets 2 m (6 ft 6¾ in) wide instead of the stock 1.5 m (4 ft 11 in) items offered by the Soviet metal industry; hence rolling mills had to be reconstructed and new thermal treatment kilns built. There were dozens – perhaps even hundreds! – of such cases when Myasishchev's new bomber programme brought about a technology upgrade.

Test crew training and preparation for the M-4's first flight proceeded in parallel with prototype construction. The first prototype was rolled out in December 1952. After the rigging procedure and ground systems checks the aircraft was dismantled and loaded on a barge which took it down the Moskva River to Zhukovskiy south-east of Moscow, the seat of the Flight Research Institute where the OKB's flight test facility was located. There, at LII's airfield, the bomber was reassembled and readied for its maiden flight.

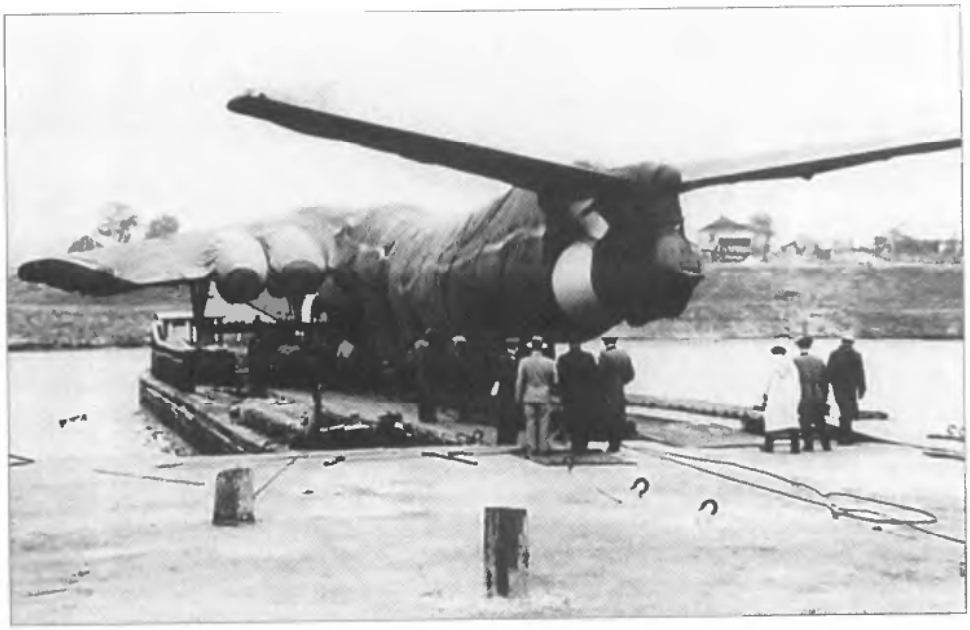
On 20th January 1953, barely one year and ten months after the establishment of OKB-23, the as-yet unserialled M-4 prototype took off on its maiden flight in spite of foul weather. The aircraft was flown by test pilots Fyodor F. Opadchiy (captain) and A. N. Gratsianskiy (co-pilot); the crew also included navigator A. I. Pomazoonov, flight engineer G. A. Nefyodov, radio operator I. I. Rykhlov and test engineers I. N. Kvitko and A. I. Nikonov. The first flight was brief, involving only a ten-minute circuit of the airfield, but it was nevertheless a major breakthrough for the entire Soviet aircraft and defence industry. A large crowd gathered to attend the first flight – including some who had hoped to see Myasishchev's new bomber crash.

The very first flight revealed a quirk – the aircraft seemed to be 'crabbing', ie, side-slipping a little. This phenomenon manifested itself again in the second test flight. The engineers speculated that rudder overcompensation might be the cause of the trouble. To check this hypothesis, Opadchiy decided to switch off the hydraulic control actuators briefly in one of the flights, going to manual control mode. No sooner had he done this when the suspicion was confirmed – the aircraft jerked sharply to one side; an immediate push of the actuator control button restored normal flight with a slight sideslip. Once the cause of the problem was known, it did not take long to fix it.

There were other minor spills, too. Despite the fact that the M-4's landing gear had passed exhaustive tests on the ShR testbed, on 25th March 1953 all four tyres on the main gear bogie blew as the aircraft touched down after its eighth flight. The cause was traced to a mismatch between the characteristics of the brake system and the anti-skid unit. However, there were pleasant surprises as well; during maximum-range tests it was established that the M-4 could carry 5,000 kg (11,020 lb) of bombs over a 10,700-km (6,645-mile) range.

As one might imagine, the first major trouble occurred in the 13th test flight. The mission was nothing out of the ordinary – the aircraft was to make level passes at different altitudes as the maximum speed was being determined. As the bomber accelerated after reaching one of the assigned altitudes, test engineer I. N. Kvitko sitting in the tail gunner's station reported that the inner and outer sections of each elevator were deflecting differentially in a scissor-like fashion, which was abnormal. Opadchiy throttled back and made

The rear fuselage of an M-4 bomber (Section F-5) on a handling dolly at plant No. 23.



Above: The first prototype M-4 is wheeled aboard a barge at plant No. 23 for the trip to Zhukovskiy. Below: Seen from the tug, the prototype (disguised by tarpaulins) cruises down the Moskva River.

for home. Back in Zhukovskiy, the engineers did not rack their brains too long about the cause of the incident, choosing to simply fix the elevator sections together by riveting metal plates over the joint.

That accomplished, the M-4 prototype took to the air again. Suddenly, as the aircraft accelerated at 3,000 m (9,840 ft), a loud bang resounded through the airframe and the bomber started climbing of its own accord, shuddering all the time. At 10,000 m (32,810 ft) Kvitko reported that one elevator had broken away completely, damaging the stabiliser and the rudder as it departed. Throttling back, Opadchiy ordered the crew to eject but, as a matter of fact, no one did.

As gently as they could the pilots turned the crippled bomber homeward. After getting down to 2,000 m (6,560 ft) Opadchiy tried a simulated flareout and discovered that, even with one elevator gone, there was still sufficient elevator authority to control the aircraft. But the nightmare was not yet over; when the runway in Zhukovskiy was already in sight the huge bomber suddenly started acting up again, dropping its nose sharply. It was the captain's instant reaction and the 5,000-m (16,400-ft) runway that saved the test aircraft and the crew. Not caring about the landing speed, Opadchiy thrust the throttles forward and the nose lifted immediately. Just as the captain closed down the throttles again, the M-4 touched down. Phew!

It turned out that the accident had been caused by the designers being over-enthusiastic with weight-saving measures. In fact, when the first prototype had been assembled and all systems checked, it turned out that the bomber was terribly overweight, the maximum take-off weight being more than 180 tons (396,825 lb) instead of the intended 155 tons (341,710 lb). The airframers had then set to work, trimming away excess weight wherever they could; as a result, the elevator skin ended up too thin, failing on the 13th flight.

The systems and equipment designers were no less enthusiastic about cutting weight – again sometimes to the detriment of safety. For instance, the avionics engineers justifiably complained about the antiquated electronic components, the electrics engineers equally rightly clamoured about the excessively heavy and inefficient generators and servo drives, etc. However, while little could be done to lighten the equipment itself, the numerous mounting racks and brackets seemed to offer unlimited scope for saving weight. This approach was bound to end in trouble sooner or later – and it did. Several years later, disaster struck when a production M-4 was undergoing tests. A fuel line failed because some of the retaining clamps had been deleted to save weight, causing the pipe to flex and break. As fuel gushed into the innards of the airframe structure, a tiny spark from a defective wire was enough to turn the entire aircraft into a blazing torch. None of the crew captained by test pilot B. K. Galitskiy managed to eject...

The second prototype was completed in December 1953, joining the first M-4 whose manufacturer's flight tests continued until 15th April 1954. This aircraft was known in-house as the DM (ie, *doobl**yor** [samol**yo**ta] M* – second prototype of 'aircraft M').

Between them the two aircraft made 46 flights during manufacturer's flight tests, logging a total of 147 hours 15 minutes. The tests were taking rather longer than expected, which meant the M-4 could not be submitted for State acceptance trials by the deadline specified by the government. Note that the Soviet government shifted this deadline twice (first to December 1953 and then to February-March 1954) by issuing special directives. In November 1953 the then Minister of Aircraft Industry Pyotr V. Dement'yev wrote to Council of Ministers Chairman Gheorgiy M. Malenkov reporting that *'...the CofM directive tasked Myasishchev with building a long-range [...] bomber powered by four 8,700-kgp* [19,1[illegible] lb st] *AM-3 engines and possessing the following performance: effective range, 9,5[illegible] km* [5,900 miles]*; top speed, 925 km/h* [5[illegible] mph]*; service ceiling over the target, 13,[illegible] m* [42,650 ft]. *The aircraft was to be submitted for State acceptance trials in May 1953. The flight test results necessitated a redesign [...] certain sub-assemblies of "aircraft M" in order to improve their structural strength and reliability. The redesign work caused the flight tests to be suspended between May and*

September 1953. [...] Due to the fact that plant No. 23 switched to IL-28 production in January 1953 the manufacture of Myasishchev bombers there was suspended. (In actual fact the plans to build the Il'yushin IL-28 *Beagle* tactical bomber at plant No. 23 never materialised – *Auth.*) *On 19th September 1953 the plant was again assigned to producing the Myasishchev bomber and the deadline for the State acceptance trials of "aircraft M" was set at December 1953.'*

Yet this revised schedule was not kept either. It was not until 30th March 1954 (ie, 15 days before the completion of the manufacturer's flight tests) that the M-4 was transferred to the Red Banner State Research Institute of the Air Force, named after Valeriy P. Chkalov (GK NII VVS – *Gosoo**darstvennyy** krasnozna**myonnyy** na**oochno**-is**sledo**vatel'skiy insti**toot** Vo**yen**no-voz**dooshn**ykh sil*) for State acceptance trials. The official date of their commencement was 15th April; in reality, however, the trials did not begin until 4th May. This was because three days earlier the first prototype M-4, by then sporting the serial '25 Red' (obviously derived from the programme's code number) writ large on the forward fuselage, took part in the traditional May Day parade in Moscow. Escorted by four Mikoyan-Gurevich MiG-17 *sans suffixe* fighters (NATO reporting name *Fresco-A*), the bomber flew over Red Square to the tremendous jubilation of the watching public – and the amazement of the attending foreign diplomats, military attachés and journalists. This public demonstration was of such importance to the Soviet political and military leaders that it was decided to postpone the State acceptance trials for more than two weeks, giving the crew time to train for the spectacular flypast over Red Square. After this event the bomber was allocated the NATO reporting name *Bison*.

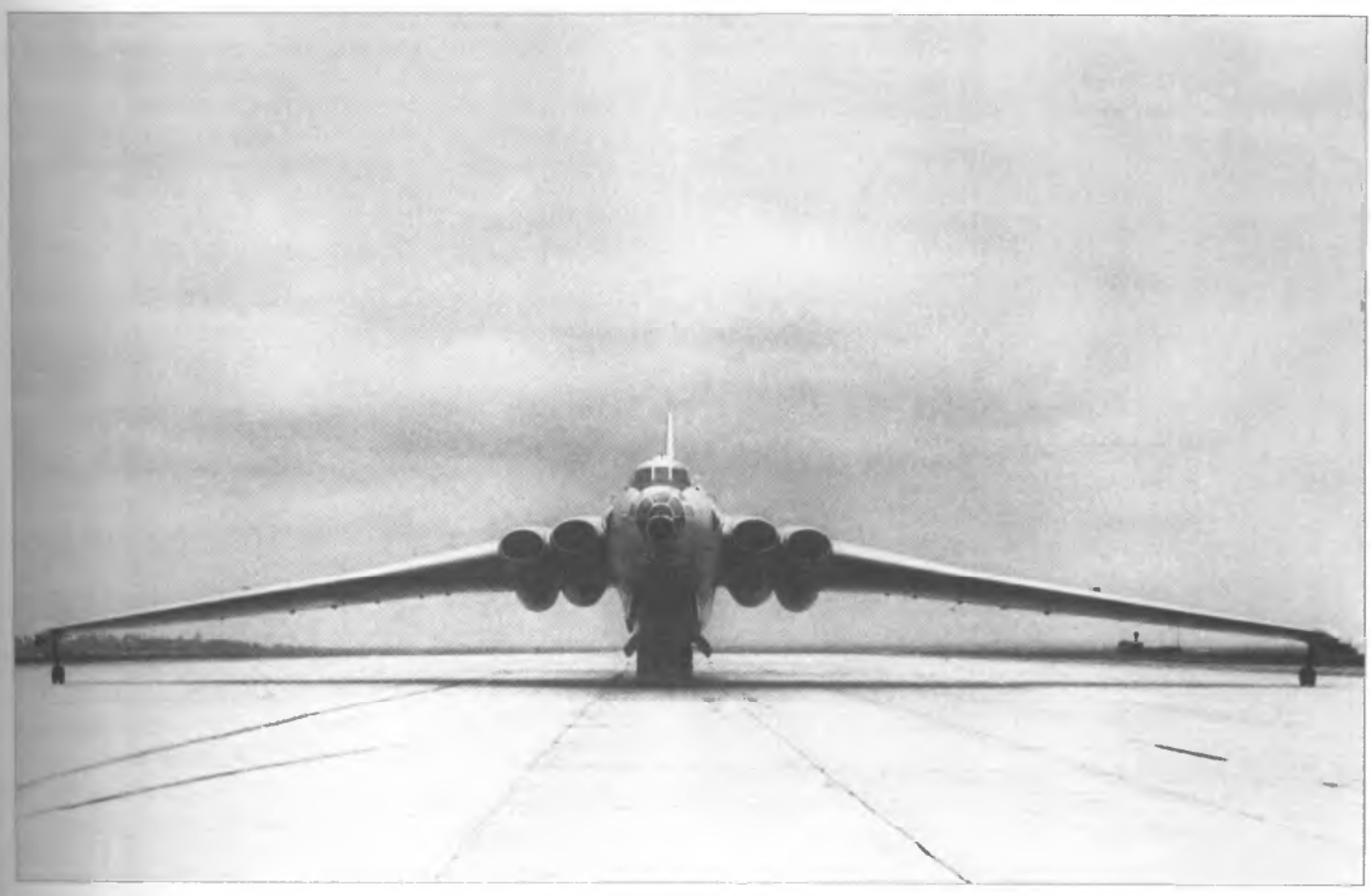
The State acceptance trials were held jointly by OKB-23, LII and GK NII VVS to hasten their completion. The greater part of the programme was performed by GK NII VVS project test pilot Col. A. V. Sarykin (captain) and Maj. V. D. Khromov (co-pilot). Other military pilots who flew the M-4 at this stage included Engineer-Colonel Kostryuk who headed the institute's Department 1, Col. Ghanechkin, Maj. Antonov, etc.; Col. Sviridenko was the M-4's project navigator during State acceptance trials. Concurrently plant No. 23 was preparing for full-scale production of the Myasishchev bomber which would supersede the Tu-4 on the assembly lines in Fili.

The trials continued until 5th August 1954 – and the results were not all encouraging. Maximum-range flights immediately showed that range was no more than 6,500 km (4,040 miles) with a full ordnance load and 9,800 km

Above and below: The first prototype M-4 serialled '25 Red' passes over Moscow's Red Square during the 1954 May Day parade in company with four MiG-17 fighters.

Above: The first prototype M-4 pictured at Zhukovskiy during initial flight tests, still without a serial. Note the star insignia on the fuselage.
Below: The same aircraft, now serialled '25 Red', taxies with the flaps fully deployed.

Above: A side view of the first prototype, showing to advantage the nose-up ground angle and the tailplane dihedral.
Below: This full frontal of the M-4 illustrates the wing anhedral and the wide landing gear track requiring extremely wide taxiways.



Above and below: The first prototype in early 1954; the serial was derived from the project's code number. Note how the W-shaped inboard flaps repeat the shape of the engine cowlings.

The first prototype begins a smoky take-off run.

(6,090 miles) with 5 tons (11,020 lb) of bombs – provided that the aircraft descended from 11,000-12,000 m (36,090-39,370 ft) and entered the airfield's holding pattern with two engines shut down to save fuel. If the bomber returned to base with all four engines running, range with a 5-ton bomb load did not exceed 9,620 km (5,975 miles); effective range with fuel reserves was more like 9,500 km (5,900 miles).

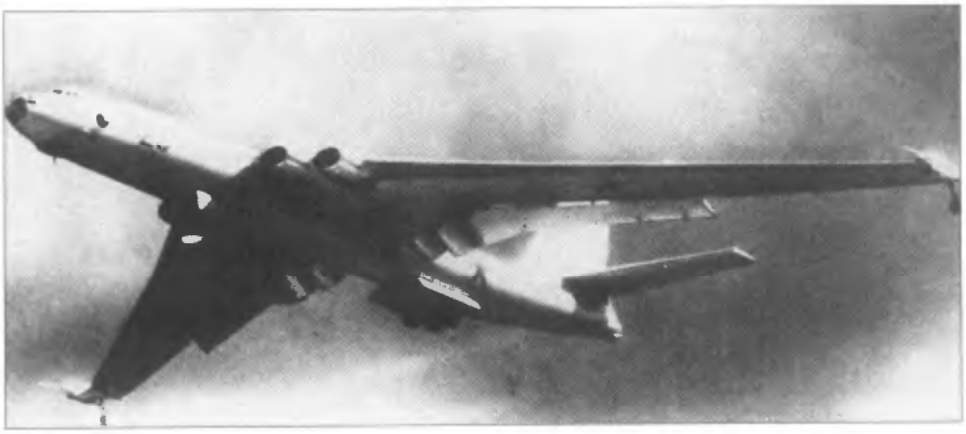
The table on this page illustrates the M-4's performance as per State acceptance trials and the protocol of the State commission. The latter was appointed by Council of Ministers directive No. 2957-1271 on 17th December 1953, with Air Marshal Sergey I. Rudenko as Chairman and Air Marshal Aleksandr A. Novikov as Vice-Chairman. The performance figures in square brackets are target figures specified by the SOR.

The defensive armament consisted of six 23-mm (.90 calibre) TKB-495 cannons installed in three powered barbettes. The ammunition supply was 500 rounds per gun for the dorsal and ventral barbettes and 800 rounds per gun for the tail barbette. The normal offensive armament comprised 5 tons (11,020 lb) of bombs, with a maximum bomb load of 24 tons (52,910 lb).

The concluding part of the State commission's protocol read as follows:

M-4 specifications as per State acceptance trials results

Powerplant	4 x Mikulin AM-3A turbojets
Engine thrust, kgp (lb st)	4 x 8,700 (19,180)
Length overall	47.66 m (156 ft 4½ in)
Wing span	50.53 m (165 ft 1¼ in)
Wing area, m² (sq. ft)	350 (3,763)
Empty weight, kg (lb)	73,595 (162,250)
Normal all-up weight with a 5-ton (11,020-lb) bomb load and half-filled fuel tanks, kg (lb)	130,000 (286,600)
Maximum all-up weight, kg (lb)	181,500 (400,130)
Nominal fuel capacity, litres (Imp. gal.)	132,390 (29,125)
Actual maximum fuel, litres (Imp. gal.)	123,600 (27,192)
Top speed, km/h (mph):	
at sea level	670 (416)
at 6,700 m (21,980 ft)	947 (588)
at 9,000 m (29,530 ft)	918 (570)
Climb time with a 138-ton (304,230-lb) maximum AUW, minutes:	
to 5,000 m (16,400 ft)	5.4
to 10,000 m (32,810 ft)	15.7
Climb time to 10,100 m (33,140 ft) with maximum AUW, minutes	29.2
Range with a 5-ton bomb load at 800 km/h (496 mph), km (miles)	9,800 (6,090) [11,000-12,000 (6,830-7,450)]
Cruise altitude in maximum-range flight, m (ft)	11,000 (36,089)
Take-off run at maximum TOW without rocket boosters, m (ft)	2,610 (8,560) [2,000 (6,560)]
Landing run with a 100-ton (220,450-lb) landing weight and a 220-km/h (136-mph) landing speed, m (ft):	
with brake parachutes	1,470 (4,820)
without brake parachutes	2,285 (7,500)



The first prototype M-4 in flight during State acceptance trials.

'1. The first prototype of the M-4 development aircraft designed by V. M. Myasishchev and powered by four AM-3A turbojet engines meets the specifications set forth in CofM directive No. 949-469 of 24.03.51 as far as the maximum speed of 918 km/h [570 mph] *at 9,000 m* [29,530 ft] *and the speed of 800 km/h* [496 mph] *in maximum-range flight mode are concerned. It fails to meet the specifications with respect to the following:*

- maximum range with a 5,000-kg bomb load (9,800 km [6,090 miles] *was attained instead of the required 11,000-12,000 km* [6,830-7,450 miles]*);*

- cruise altitude in maximum-range flight mode (8,500-13,500 m [27,890-44,290 ft] *instead of the required 13,000-16,000 m* [42,650-52,490 ft]*);*

- take-off run at maximum TOW without rocket boosters (2,610 m [8,560 ft] *instead of the required 2,000 m* [6,560 ft]*).*

'2. The decision on whether the aircraft is suitable for Air Force service can be taken when the cannon and bomb armament and other systems not tested and verified on the first aircraft have passed their State acceptance trials on the second prototype.

'3. The M-4 is a modern high-speed bomber. It can be mastered by average-skilled pilots flying the Tu-4 and Tu-14 (a twin-jet tactical bomber and torpedo-bomber, NATO reporting name *Bosun – Auth.*) *and is capable of operating at altitudes up to its service ceiling and at speeds ranging from a minimum of 670 km/h* [416 mph] *to a maximum of Mach 0.85. Flight at speeds in excess of Mach 0.85 is not recommended due to considerable vibration of the entire aircraft.*

'The crew's working conditions are unsatisfactory as they cause excessive crew fatigue.

Signed:
GK NII VVS Department 1
Chief Engineer-Colonel Kostryuk 19.08.54
GK NII VVS Department 2
Chief Engineer-Colonel Titov 20.08.54
GK NII VVS Department 3
Chief Major-General Shelimov
(aircraft maintenance service).'

The report also stated that the M-4's roll stability deteriorated at speeds in excess of Mach 0.81-0.82 and the aircraft displayed reverse roll reaction to rudder inputs at these speeds (ie, it rolled right instead of left when left rudder was applied). In 'clean' configuration (with the landing gear and flaps up) the aircraft displayed longitudinal instability at high angles of attack. The forces on the aileron control wheels were rather high at medium and high speeds. When the powered flight controls were switched off and the emergency manual mode tried, the control runs became deformed, requiring much bigger control inputs to achieve the desired reaction. Finally, in rainy weather the flightdeck glazing was flooded with water to such an extent as to make landing all but impossible – forward visibility dropped virtually to zero.

The Myasishchev OKB took due notice of these findings. The deficiencies discovered in the process of State acceptance trials were rectified on the prototypes and initial production aircraft, and appropriate changes were introduced on the production line. However, new problems cropped up as old ones were eliminated. For instance, during maximum-range flights it transpired that the aircraft's 1-RSB-70 communications radio had a range of only 3,000-3,850 km (1,860-2,390 miles) when working with ground-based Boonker (bunker) transmitters and R-250 receivers; in practice this meant long-range bomber crews would have no radio contact with the ground most of the time!

Yet the OKB did not agree with all of the State commission's findings, arguing that some of the more serious objections were unfounded. On 7th September 1954 Aleksey I. Shakhoorin, who had returned to MAP after Stalin's death in 1953 (he had been fired as People's Commissar of Aircraft Industry in March 1946 for slow progress in jet fighter development), wrote as follows to the Council of Ministers' Machinery Industries Bureau:

'State acceptance trials of the first prototype M-4 powered by AM-3 engines were completed on 30th July 1954. [...] The State commission holding the trials of the M-4 notes that the aircraft's performance meets the specifications set forth in Council of Ministers directive No. 949-469 of 24th March 1951, with the exception of maximum technical range and take-off run without the assistance of rocket boosters.

'Chief Designer Comrade Myasishchev believes that GK NII VVS incorrectly determined the aircraft's maximum range in the test flight on 21st July. He argues that the amount of unusable fuel is actually much smaller than the figure quoted by the Air Force, being 250 kg [551 lb] *rather than 1,450 kg* [3,196 lb], *and that the amount of fuel required for taxying to the hardstand after landing was not included in the 5% remaining after landing. As a result, the M-4's range ended up being 500 km* [310 miles] *less than the figure obtained during manufacturer's flight tests.*

'The 2,610-m take-off run recorded during State acceptance trials cannot be regarded as a minimum figure either because the first prototype M-4 lacks the increased-area flaps fitted to the second aircraft; besides, the take-off technique involving nose gear bogie tilting has not yet been mastered by the crew, as a maximum take-off weight mission has only been flown once to date. During manufacturer's flight tests the second prototype demonstrated a shorter take-off run of approximately 2,000-2,200 m [6,560-7,220 ft].

'[...] The delays in the manufacturer's flight test programme of the second prototype M-4 were caused by procrastination in resolving the issue of extending the AM-3 engine's time between overhauls from 100 to 150 hours.'

Before the onset of *perestroika* ('restructuring') – the policy of democratisation, openness and 'new thinking' launched by the first-and-only Soviet President Mikhail S. Gorbachov – the Soviet popular press frequently embellished the M-4 while trying to 'play down' the importance of its chief Soviet 'competitor', the Tu-95 (NATO reporting name *Bear*). For example, Vladimir M. Myasishchev's former deputy V. K. Karrask wrote in one of his publications: *'The Tupolev OKB, which then held a monopoly in the field of heavy aircraft development, considered it impossible to create an equivalent to the qualitatively new Boeing B-52 in the conditions prevalent in the Soviet Union, proposing a turboprop aircraft instead. This aircraft (the Tu-95) was, in effect, an extension of the traditional [bomber design] concept which had by then reached the limit of its resources; thus it could not match the B-52's capabilities in full.*

'After the war [...] V. M. Myasishchev developed a number of turbojet-powered aircraft projects. This work culminated in his offer to create a jet-powered strategic bomber having transcontinental range and able to compete with the Boeing B-52 in all aspects.'

However, this salesman's pep talk no longer worked when the actual performance figures of the *Bear* and the *Bison* had been disclosed, showing that the praise lavished on the M-4 by its proponents was somewhat exaggerated. For instance, although the M-4 was 57 km/h (35 mph) faster than the Tu-95 with an identical 5-ton (11,020-lb) bomb load, its range in these conditions was 5,000 km (3,105 miles) shorter; also, the M-4 had an operational G limit of 2 and a never-exceed speed (V_{NE}) of Mach 0.9.

The tone of Karrask's publication echoes the intense rivalry between the Tupolev and Myasishchev bureaux as 'the Lion and the Unicorn were fighting for the crown' (the Soviet bomber crown, that is). Yet no documentary proof has been found of Vladimir M. Myasishchev attacking Andrey N. Tupolev, whereas cases of the reverse were plenty. (Speaking of which, Myasishchev was one of the best disciples of the eldest Soviet aircraft designer, as was the famous 'fighter maker' Pavel Osipovich Sukhoi. That explains the 'pecking order' perhaps?) Defending the Tu-95, Andrey N. Tupolev railed against the M-4 in 1954; however, Mikhail V. Khrunichev, who was then CofM Vice-Chairman, unexpectedly supported Myasishchev. In July 1954 he wrote to Nikita S. Khrushchov:

'With regard to Chief Designer Comrade Tupolev's memo concerning the main performance data of the "aircraft M" bomber designed by Comrade Myasishchev, I report the following:

'[...] The actual flight performance of the "aircraft M" bomber is as follows: (see table)

Above: The forward fuselage of the first prototype M-4. Note the undernose aerial of the instrument landing system (iLS) and the gentiy eiliptical shape of the laterai sighting biisters.

'Regarding Comrade Tupolev's comments about the "aircraft M" bomber stated in the text of the memo, the facts are as follows:

- Item 1 alleging that, in its current form, "aircraft M" is incapable of reaching any vital targets in the USA – this needs to be checked with the Ministry of Defence, taking into account the positioning of our airfields and the flight routes, but, according to Chief Designer Comrade Myasishchev's calculations, "aircraft M" can reach aircraft factories in the northern part of the USA;

- Item 2 [...] – if the aircraft is refuelled in flight near the airfield [of origin], effective

	manufacturer's flight tests report	Comrade Tupolev's memo
Top speed, km/h [mph]	962 [597.5]	925 [574.5]
Cruising speed, km/h [mph]	800 [497]	800 [497]
Take-off run at MTOW, m [ft]	2,970 [9,740]	3,250 [10,660]
Technical range, km [miles]	10,700 [6,645]	10,600 [6,580]
Effective range with one fuel top-up, km [miles]	12,650 [7,860]	11,500-12,000 [6,830-7,450]

The first prototype a few seconds after becoming airborne. Note the almost-level position of the nose gear bogie indicating that the aircraft was not yet fitted with a bogie tilting mechanism to reduce the take-off run.

Above and below: The second prototype M-4 ('aircraft DM') taxies during initial flight tests; the aircraft was totally devoid of markings at this stage. Note the open bomb bay doors.

Above: Another shot of the second prototype during initial tests, showing the increased-area flaps.
Below: 'Aircraft DM' at a later stage of the test programme, now wearing its c/n (4300003) and a black anti-glare panel, but still no red star insignia.

Above and below: A mid-production M-4 (c/n 5301114) with the tactical code '24 Red' seen during State acceptance trials of the bomber's armament; this was the 11th production aircraft and the 14th M-4 built.

A three-quarters rear view of M-4 '24 Red' (c/n 5301114) with the flaps at minimum deflection.

range will be 15,000 km [9,320 miles]*; if refuelling takes place en route to the target, the range will be 17,000 km* [10,560 miles]*, making it possible to strike at many of the USA's [political and industrial] centres;*

- Item 3 alleging that the take-off (ie, field performance – *Auth.*) *problem remains unresolved – in actual fact, the take-off run in maximum TOW (overload) configuration in standard conditions (ISA +15°C) is 2,970 m* [1,844 miles] *(this figure comes from the manufacturer's flight tests report). However, according to Comrade Myasishchev's calculations, the second prototype "aircraft M" and the first production aircraft are expected to have a take-off run of 2,600 m* [8,530 ft] *thanks to an improved flap design.*

'Comrade Tupolev's claim that the take-off run will exceed 4,000 m [13,120 ft] *at higher ambient temperatures is equally applicable to all long-range bombers, as engine thrust decreases in hot conditions and, according to Comrade Myasishchev's OKB, the take-off run grows by 400 m* [1,310 ft] *with every 10°C. This rule applies equally to turbojet and turboprop engines.'*

Here it is worth noting that, although the Tu-95's performance was fairly high and the *Bear* surpassed the M-4 in range, it did not meet its design specifications in full either! The draft of the Tu-95's State acceptance trials protocol prepared by GK NII VVS in 1956 read:

'...the Tu-95 aircraft powered by NK-12 engines possesses the following performance:

a) maximum technical range with a 5,000-kg [11,020-lb] *bomb load, full main fuel tanks and a normal all-up weight of 156 tons* [343,915 lb] *does not exceed 12,970 km* [8,055 miles]*, whereas the required figure is 15,000 km* [9,320 miles]*. With a full fuel load and a 172-ton* [379,190-lb] *maximum TOW, range is 15,040 km* [9,340 miles] *instead of the specified 17,000-18,000 km* [10,560-11,180 miles]*;*

b) maximum speed is 890 km/h [552 mph] *at 7,000 m* [22,965 ft] *instead of the specified 920-950 km/h* [570-590 mph] *at 8,000-9,000 m* [26,250-29,530 ft]*;*

c) service ceiling with an average all-up weight of 120 tons [264,550 lb] *is 11,300 m* [37,070 ft] *instead of the specified 13,000-14,000 m* [42,650-45,930 ft]*;*

d) the take-off run is 1,740-2,260 m [5,710-7,410 ft] *depending on take-off weight instead of the specified 1,500-1,800 m* [4,920-5,900 ft]*.'*

Anyway, in a trans-Atlantic or trans-Pacific mission the Tu-95 gave the crew a chance of returning home safely – or at least of reaching an area under the control of friendly forces where the crew could bale out and be rescued. The M-4 did not. The obvious question is, why? Why didn't Myasishchev achieve the required range? Given the extremely fuel-thirsty jet engines of the day, all the Myasishchev OKB could do to meet the stringent requirements was to give the M-4 an excellent lift/drag ratio, provided by the bomber's 'clean' wings of extremely high aspect ratio (17.45). Yet this was not enough, as it turned out. The only way to extend the M-4's range was by increasing the fuel capacity; this would increase the take-off weight (which was limited by the landing gear's strength) and the runway loading. Anticipating this problem, the OKB had considered a combined 'bicycle/tricycle' landing gear for the 'aircraft M' bomber back at the ADP stage. Quite simply, two auxiliary struts equipped with four-wheel bogies were to be fitted under the wings just outboard of the engines for take-off; the centreline main gear unit and the wingtip outrigger struts would be retracted once airborne. After take-off the auxiliary struts would be jettisoned, the aircraft subsequently landing in normal bicycle-gear configuration.

Despite the fact that the M-4 fell short of the expectations as far as range and some other characteristics were concerned, it was

Above: The crew of the second prototype M-4 after setting six world speed records on 30th October 1959

decided to field the new jet bomber, upgrading it in order to obtain the desired performance as soon as possible. This was a political decision aimed at achieving real parity in the arms race against the USA. The bottom line was that, even though OKB-23 had managed to design, build and test-fly the new strategic bomber two months ahead of schedule (Stalin had given Myasishchev two years to complete the job), it did not succeed in either achieving the targeted 12,000-km (7,450-mile) range or in beating the Americans; the first prototype XB-52 entered flight test on 15th April 1952, followed by the second prototype (YB-52) on 2nd October that year.

Another reason behind the decision to put the M-4 into production and service was the Tu-95's development problems. Powered by Kuznetsov 2TV-2F coupled turboprops, the first prototype ('aircraft 95/1') took to the air on 12th November 1952, ahead of the Myasishchev bomber. However, the fatal crash of the '95/1' on 17th May 1953 (traced to a defective engine) led to the decision to use Kuznetsov TV-12 (NK-12) turboprops instead, the protracted testing of the new engine causing considerable delays. The second prototype ('aircraft 95/2') powered by NK-12s did not enter flight test until 16th February 1955, by which time M-4 production was well under way at plant No. 23 and the aircraft was undergoing evaluation at Engels-2 airbase near Saratov in southern Russia.

However, now we have to go back in time a bit. The second prototype, aka 'aircraft DM' (c/n 4300003), was completed in 1954; it differed from the first prototype in having a revised nose gear unit featuring the tilting bogie which increased the angle of attack from 7° 30' to 10° 30' immediately before lift-off. (Production M-4s had a 9° 30' angle of attack before lift-off.) The first prototype was later retrofitted with the new bogie; the redesigned nose gear unit functioned well and was recommended for production after 18 test flights. Additionally, 'aircraft DM' differed in having a cranked wing trailing edge, the sweep being reduced on the inboard portions to increase wing area (less flaps) by 5.75 m² (61.8 sq. ft) and flap area by 6.9 m² (74.2 sq. ft); the rear fuselage was shortened by 1 m (3 ft 3⅜ in) and the rear fuselage fuel cells were rearranged.

The second prototype was effectively the pattern aircraft for series production, featuring a complete avionics and equipment fit. This included a 1-RSB-70M HF communications radio and an RSIU-3M UHF command radio, an SPU-10 intercom (*samo**lyot**noye pereg**o**-**vor**noye oo**stroy**stvo*), an ARK-5 Amur automatic direction finder (ADF – *avtoma**tich**eskiy **rah**dio**kom**pas*), an RBP-4 Roobidiy-MM-II panoramic navigation/ground mapping radar (***rah**diolokatsi**on**nyy bombardi**rov**ochnyy **prit-sel*** – radar bomb sight) in a chin radome, a PRS-1 Argon gun-laying radar (***pritsel rah**di-olokatsi**on**nyy strel**kov**yy*** – radar gunsight) installed at the base of the rudder above the tail gunner's station, an SRO-1 Bariy (Barium) identification friend-or-foe transponder (*samo**lyot**nyy **rah**diolokatsi**on**nyy o**tvet**chik* – lit. 'aircraft-mounted radar responder'), an MRP-48 Dyatel (Woodpecker) marker beacon receiver (***mar**kernyy **rah**diopree**yom**nik*), RV-2 Kristall (Crystal) and RV-17 high-range and low-range radio altimeters (***rah**diovyso-to**mer***), etc. The 'aircraft DM' featured an AP-5 autopilot, while production aircraft were equipped with the later AP-15 model.

The targeting equipment included PS-48 gunsights (*pr**itsel'**naya **stah**ntsiya* – 'sighting station'), an OPB-11S optical bomb sight (*op**tich**eskiy bombardi**rov**ochnyy pri**tsel***) and strike cameras. The SPV-25 defensive armament system (*si**stema push**echnovo vo'ooro-**zhen**iya*) consisted of six 23-mm (.90 calibre) Afanas'yev/Makarov AM-23 cannons (alias TKB-495A); these were installed in three powered turrets – a DB-33A dorsal turret, a DB-34A ventral turret and a DB-35AM tail turret (DB = *distantsi**on**no oopravl**ya**yemaya **bahsh**nya* – remote-controlled turret). The offensive armament comprised free-fall bombs weighing up to 9,000 kg (19,840 lb) each; the maximum design ordnance load was 24 tons (52,910 lb). In theory the M-4's bomb bay could take up to three 6,000-kg (13,230-lb) bombs; in practice, however, they could never cram more than two 6,000-kg bombs or one 9,000-kg bomb into the aircraft.

The manufacturer's flight tests of 'aircraft DM' began on 1st April 1954, involving 32 flights and lasting almost a full year. The PS-48 gunsights proved particularly troublesome and were eventually substituted with PS-53 gunsights featuring VB-53M ballistic computers (*vychis**litel'** **ballis**tich**eskiy*).

On 26th March 1955 the second prototype was transferred to GK NII VVS; however, State acceptance trials were delayed until 10th May because the aircraft was used for conversion training of long-range bomber crews and participated in that year's May Day parade. This time the trials also involved the upgraded first prototype and the 11th production M-4 serialled '24 Red' (c/n 5301114).

(Note: M-4 construction numbers are deciphered as follows. For example, 5301114, the first digit again denotes the year of manufacture (1955), the second one is always a 3 and is derived from the plant's number by omitting the 2 in order to confuse would-be spies. The remaining digits are not the production batch number and the number of the aircraft in the batch, as was customary in the Soviet Union, but denote this is the 11th production aircraft and the 14th M-4 built! The c/n was stencilled in large characters on the fuselage nose and at the base of the fin.)

Between 9th September 1955 and 7th July 1956 the aircraft's offensive and defensive armament underwent an upgrade involving the replacement of the powered barbettes and the PRS-1 gun-laying radar. After that the aircraft underwent renewed State acceptance trials (or rather Stage B of same); these revealed that the performance of the production aircraft differed little from that of the prototype (for better or for worse). It was noted, however, that night take-off in poor weather was dangerous because the aircraft pitched up sharply as the nose gear bogie tilted, approaching critical AOAs. High gross weight take-offs at low speed when the flight controls were still ineffective represented the greatest risk.

Later on, the first prototype served as a test and development aircraft with OKB-23; among other things, it was a propulsion test bed for the Dobrynin VD-7 turbojets used on other aircraft of the M-4 family and a testbed for the fuel tank inert gas pressurisation system to prevent an explosion if the aircraft was hit by enemy fire. The second prototype served in a similar capacity as a systems testbed for the ill-starred Myasishchev M-50 *Bounder* four-jet supersonic bomber.

In 1957 a group of OKB-23 employees (Vladimir M. Myasishchev, Gheorgiy Nazarov, V. M. Baryshev, L. M. Rodnyanskiy, Fyodor F. Opadchiy and Leonid L. Selyakov) received the Lenin Prize – one of the highest government awards in the Soviet Union – for their major contribution to the development of Soviet strategic aviation.

Chapter 3

A Herd of Wild *Bison*

Version and Mission Variety

M-4 *Bison-A* long-range bomber (*izdeliye* 25)

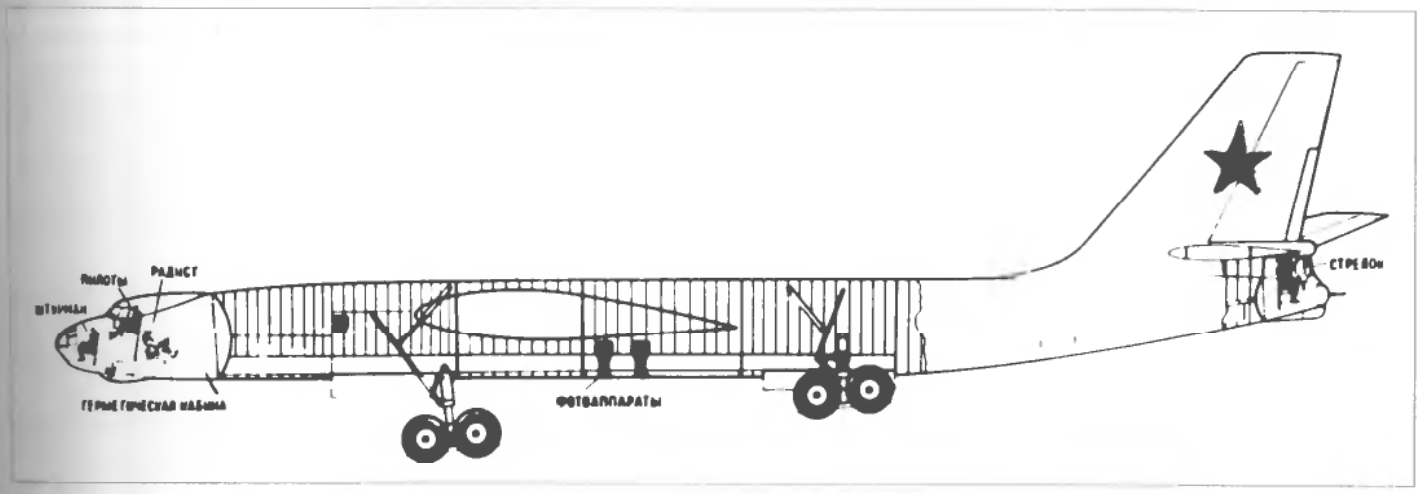
Full-scale production of the M-4 got under way at aircraft factory No. 23 in 1954. The tremendous efforts of the Soviet aircraft industry bore fruit: the Soviet Union became the world's first nation to field a new-generation strategic bomber (the M-4 achieved initial operational capability (IOC) when the B-52 was still undergoing trials). Moreover, Tupolev's turboprop competitor (the Tu-95) was running behind schedule as well. Indeed, the M-4 was remarkable in that it was way ahead of many aircraft of simpler design in terms of service entry.

According to some sources, Batch Zero comprised three aircraft – two flying prototypes (c/ns 0001 and 4300003) and a static test airframe (c/n 0002); subsequent production batches consisted of a single aircraft each. However, it would be more appropriate to say the M-4 had no production batches as such and that the production aircraft were numbered consecutively. Anyway, the first production M-4 was c/n 4300104 (ie, the fourth airframe built).

Outwardly, production *Bisons* differed from the prototypes in lacking external spent case collectors under the tail turret and in having a different communications radio aerial arrangement. Unlike the prototypes, production bombers featured a complete avionics and equipment suite; conversely, the number of weapons options was reduced by excluding anti-shipping mines, torpedoes and guided bombs from the weapons range. The first few production aircraft participated in the State acceptance trials programme alongside the prototypes and were used for conversion training of service pilots which took place at the Myasishchev OKB's flight test facility in Zhukovskiy.

Above: An early M-4 coded '31 Red' passes over Moscow's Red Square during one of the May Day parades. Note the absence of star insignia on the fuselage, indicating that the photo was taken after 1955.

As already mentioned, the first prototype had been dismantled and literally shipped to Zhukovskiy prior to its maiden flight. However, in order to accelerate delivery of production bombers it was desirable to avoid this complicated procedure if at all possible. (Quite apart from the effort involved in dismantling, loading, unloading and reassembling the aircraft, the way downstream from Fili to Zhukovskiy took the barges through the centre of Moscow, necessitating large-scale security measures; this was a time when everybody was paranoid about espionage. Suffice it to say that part of the route lay past the famous Hotel Rossiya where a lot of foreigners stayed!) The problem was that plant No. 23 possessed only a short runway no more than 1,500 m (4,920 ft) long. The solution was to reduce the bomber's take-off weight by filling just enough fuel for one hour's flight. Vladimir M. Myasishchev gave the go-ahead for this experiment which was flawlessly performed by a test crew under



A cutaway drawing depicting the layout of the 'aircraft 25F' (VM-25F) photo reconnaissance aircraft's fuselage. Note the cameras installed in the bomb bay.

Appropriately coded '26', this display model depicts the projected 'aircraft 26' (VM-26) – a derivative of the M-4 powered by two Dobrynin VD-5 axial-flow turbojets.

B. K. Galitskiy on M-4 c/n 4300104; from then on, all production *Bisons* were ferried to Zhukovskiy in this fashion.

This technique gave an important bonus – in case of need the M-4 could operate from virtually any Soviet airbase. Until then the *Bisons* were authorised to use only a handful of bases possessing long runways – Engels-2 near Saratov (southern Russia), Siauliai (Lithuania), Semipalatinsk (Kazakhstan), Dyaghilevo near Ryazan' (central Russia), Seryshevo and Ookraïnka (both located in the Soviet Far East). Incidentally, Dyaghilevo AB was the seat of the DA's 43rd Combat & Conversion Training Centre (TsBP i PLS – *Tsentr boyevoy podgotovki i pereoochivaniya lyotnovo sostava*), as well as the Air Force's aircraft overhaul plant No. 360 which was responsible for M-4 refurbishment. Soon the service pilots discovered for themselves that with a reduced take-off weight the M-4 really leaped into the air.

Table 1. Provisional specifications of the 'aircraft 25F' (VM-25F)

Fuselage length (length overall?)	45.6 m (149 ft 7¼ in)
Height on ground	11.35 m (37 ft 2⅛ in)
Wing span	49.84 m (163 ft 6¼ in)
Total wing area, m² (sq. ft)	330 (3,548)
Wing area less leading-edge root extensions, m² (sq. ft)	283 (3,043)
Bomb load, kg (lb):	
normal	5,000 (11,020)
maximum	24,000 (52,910)
Top speed at 9,000 m (29,530 ft), km/h (mph)	920-940 (570-583)
Cruising speed, km/h (mph)	800 (496)
Flight altitude over the target, m (ft)	12,800 (42,000)
Technical range with a 5-ton (11,020-lb) bomb load, km (miles)	10,500 (6,520)

Table 2. Provisional specifications of the 'aircraft 25D' (VM-25D)

Fuselage length (length overall?)	45.6 m (149 ft 7¼ in)
Height on ground	11.35 m (37 ft 2⅛ in)
Wing span	49.84 m (163 ft 6¼ in)
Total wing area, m² (sq. ft)	330 (3,548)
Wing area less leading-edge root extensions, m² (sq. ft)	283 (3,043)
Empty weight, kg (lb)	63,800 (140,650)
Take-off weight, kg (lb)	160,000 (352,730)
Fuel load, kg (lb)	89,500 (197,310)
Bomb load, kg (lb):	
normal	5,000 (11,020)
maximum	24,000 (52,910)
Top speed at 9,000 m (29,530 ft), km/h (mph)	900-920 (560-570)
Cruising speed, km/h (mph)	800 (496)
Flight altitude over the target, m (ft)	12,200 (40,030)
Service ceiling over the target, m (ft)	13,800 (45,280)
Technical range with a 5-ton (11,020-lb) bomb load, km (miles)	11,850 (7,360)

In 1955 plant No. 23 started manufacturing M-4s powered by RD-3M or RD-3M-500A turbojets which were advanced versions of the AM-3A developed by Aleksandr A. Mikulin's deputy Prokofiy F. Zoobets; the existing *Bison* fleet was progressively re-engined by 1957. Besides being more fuel-efficient, the RD-3M offered higher thrust, with a normal take-off rating of 9,500 kgp (20,940 lb st) and a 10,500-kgp (23,150-lb st) contingency rating which allowed take-off to be continued in the event of an engine failure. The new powerplant also increased range with a 5-ton (11,020-lb) bomb load to 10,500 km (6,520 miles). (In passing, it may be noted that Zoobets became the new chief of the OKB-500 engine design bureau when Mikulin fell into disfavour at the top level and was removed from office. Consequently the use of Mikulin's initials as an engine designation became taboo, and the AM-3 was promptly rechristened RD-3 for *reaktivnyy dvigatel'* – jet engine.)

Originally known simply as the *Bison* in NATO parlance, the initial 'glass-nosed' bomber became the *Bison-A* when new versions appeared and were identified by the West, necessitating the addition of suffix letters. The Western popular press sometimes referred to the M-4 by the name *Molot* (Sledgehammer). The origin is obscure but the name is a fitting one – from a Western viewpoint anyway, as the shape of the M-4 in plan view is not unlike Thor's Hammer!

'Aircraft 25F' high-altitude PHOTINT aircraft project (VM-25F, *izdeliye* 25F)

The designation 'aircraft 25F' or VM-25F (*fotorazvedchik* – photo reconnaissance aircraft) applied to a projected dedicated photo reconnaissance (PHOTINT) version of the original M-4 powered by AM-3A engines with a take-off rating of 8,750 kgp (19,290 lb st) and a nominal rating of 7,000 kgp (15,430 lb st). The aircraft was to have a crew of five (two pilots, a navigator, a radio operator and a gunner); the defensive armament was reduced to a single tail barbette with two 23-mm cannons. The battery of cameras was housed in the former bomb bay.

The provisional specifications of the VM-25F are given in Table 1.

'Aircraft 25D' long-range fast bomber project (VM-25D, *izdeliye* 25D)

This projected version differed from the basic M-4 mainly in featuring a 6-m² (64.5-sq. ft) increase in flap area and having provisions for carrying air-to-surface missiles. Once again the powerplant consisted of four AM-3A turbojets. The aircraft was to feature in-flight refuelling (IFR) capability, which most likely accounts for the D suffix to the designation (D = *dahl'niy* – long-range). The nose

unit incorporated a 'jump strut' to increase the angle of attack for take-off.

The provisional specifications of 'aircraft 25D' are given in Table 2.

'Aircraft 26' long-range fast bomber project (VM-26, *izdeliye* 26)

This projected derivative of the basic *Bison-A* (*izdeliye* 25) featured redesigned inner wing sections to accommodate a new powerplant – two Dobrynin VD-5 axial-flow turbojets with a take-off rating of 13,000 kgp (28,660 lb st) and a nominal rating of 11,000 kgp (24,250 lb st). Like the production bomber, the VM-26 had a crew of eight; the defensive armament was likewise identical to that of the M-4, comprising six 23-mm cannons in three powered barbettes. Provision was made for jet-assisted take-off (JATO) boosters – two large booster rockets delivering 9,000 kgp (19,840 lb st) apiece were to be mounted under the wing roots.

The provisional specifications of 'aircraft 26' are given in Table 3.

'Aircraft 28' high-altitude strategic bomber project (VM-28, 2M, *izdeliye* 28)

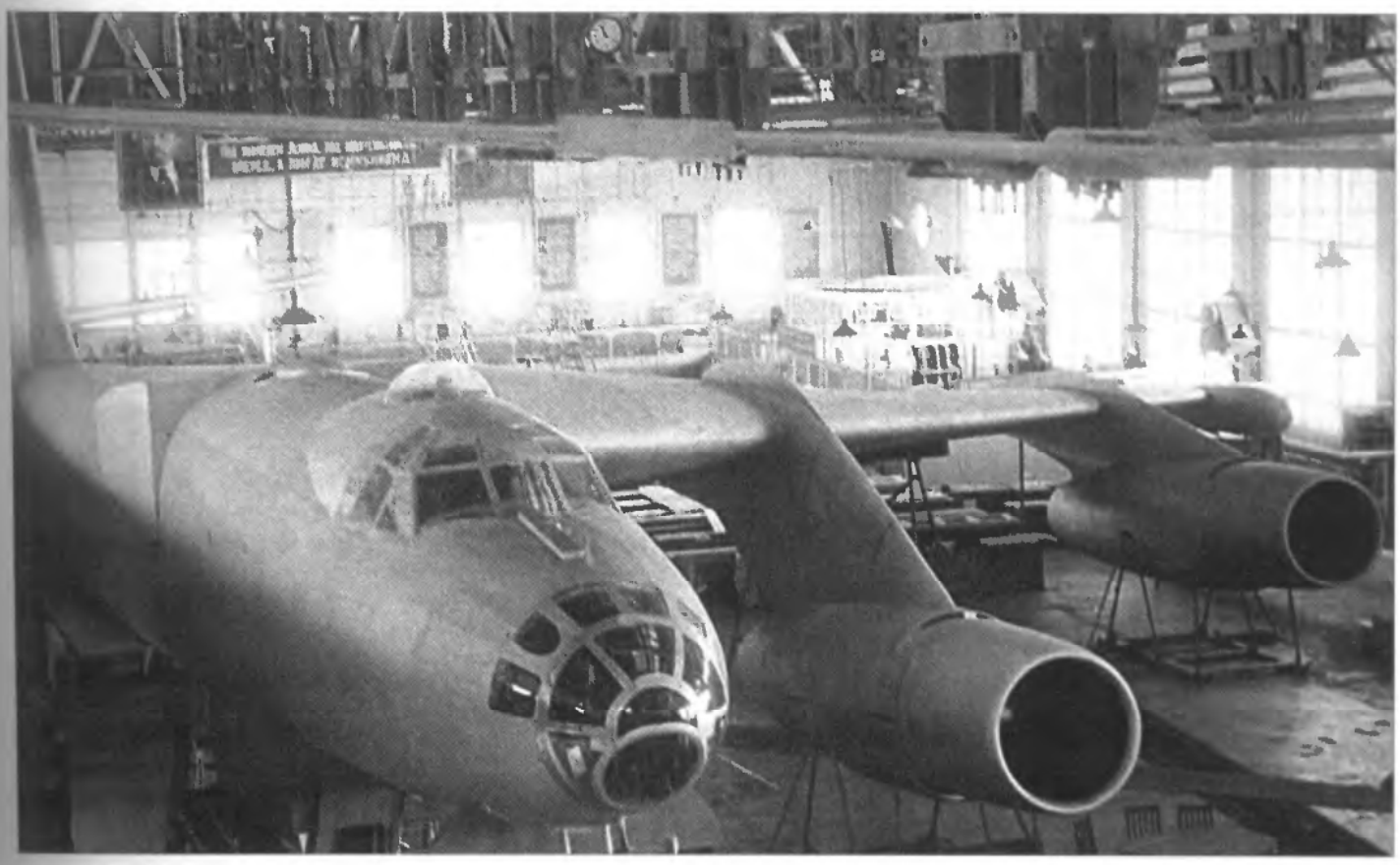
Back in August 1951, when the Myasishchev OKB was working on the advanced development project of the SDB bomber, it became clear that the aircraft's maximum range would be attained at altitudes ranging from 8,500 to 14,000 m (27,890-45,930 ft). However, insuffi-

Table 3. Provisional specifications of 'aircraft 26' (VM-26)

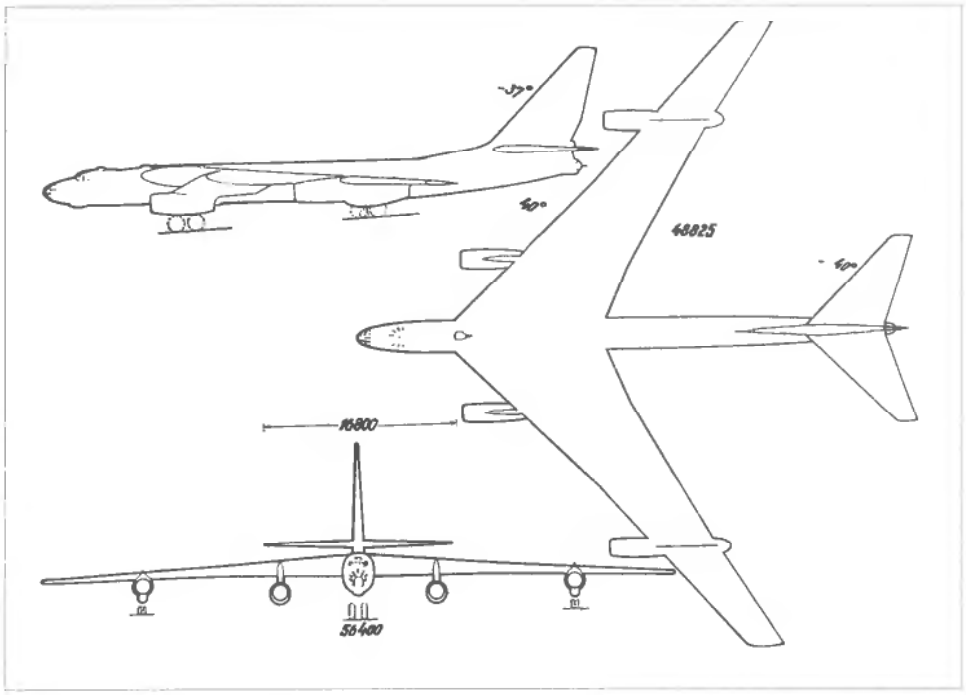
	Version 1	Version 2
Length overall (fuselage length?)	48.75 m (159 ft 11¼ in)	48.75 m (159 ft 11¼ in)
Wing span	53.0 m (173 ft 10⅝ in)	53.0 m (173 ft 10⅝ in)
Total wing area, m² (sq. ft)	355 (3,817)	355 (3,817)
Wing area less leading-edge root extensions, m² (sq. ft)	308 (3,311)	308 (3,311)
Empty weight, kg (lb)	68,000 (149,910)	68,000 (149,910)
Fuel load, kg (lb)	53,000 (116,840)	53,000 (116,840)
Take-off weight, kg (lb)	105.000 (231.480)	120,000 (264.550)
Cruising speed, km/h (mph)	750-800 (465-496)	760-800 (472-496)
Flight altitude over the target at half-range, m (ft)	16,000-16,500 (52,500-54,130)	16,200-16,700 (53,150-54,790)
Technical range, km (miles)	7,000-7,500 (4,350-4,660)	5,000-5,500 (3,100-3,420)
Top speed at 9,000 m (29,530 ft), km/h (mph)	910 (565)	910 (565)

Table 4. Provisional specifications of 'aircraft 28' (VM-28, 2M)

	Version 1	Version 2
Fuselage length	48.82 m (160 ft 2¼ in)	47.6 m (156 ft 2 in)
Wing span	56.4 m (185 ft ½ in)	55.8 m (183 ft ⅞ in)
Total wing area, m² (sq. ft)	429 (4,612)	429 (4,612)
Wing area less leading-edge root extensions, m² (sq. ft)	390 (4,193)	390 (4,193)
Flight altitude over the target, m (ft)	17,000 (55,770)	16,000 (52,500)
Take-off weight, kg (lb)	146.000 (321,870)	180,000 (396,825)
Empty weight, kg (lb)	74.000 (163.140)	74.000 (163.140)
Fuel load, kg (lb)	66,500 (146,600)	100,000 (220,460)
Technical range with a 5-ton (11,020-lb) bomb load, km (miles)	7,680 (4,770)	10,510 (6,527)
Take-off run, m (ft)	1,000 (3,280)	1,600 (5,250)
Service ceiling, m (ft	17,300 (56,760)	16,600 (54,460)
Cruising speed at 9,000 m (29,530 ft), km/h (mph)	940-970 (580-600)	940-970 (580-600)



This full-scale mock-up represents the final configuration of the 'aircraft 28' (2M) bomber with the engines in widely spaced individual nacelles. Note that the outrigger strut fairings are located some way inboard from the wingtips; also, the sighting blisters on the forward fuselage sides are missing.



Above: The penultimate version of the 'aircraft 28' project. The outer engine nacelles adhere directly to the wing underside *à la* Boeing B-47 and the outrigger struts retract into these nacelles in the same fashion.

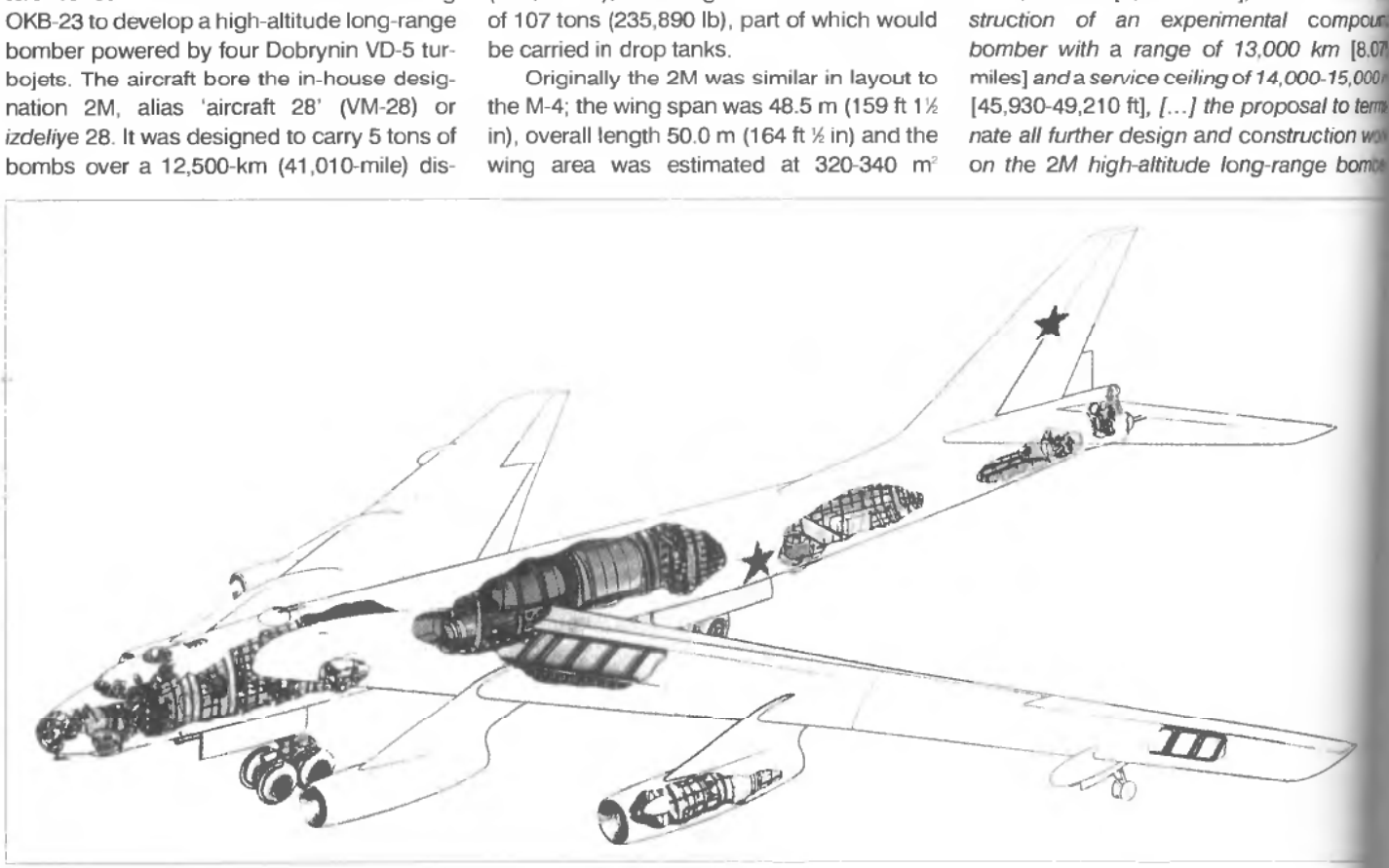
cient wing lift prevented the later 'aircraft M' from reaching really high altitudes where it would be safe from the potential adversary's air defences; in this respect the Soviet bomber was markedly inferior to the B-52.

On 29th March 1952 the Council of Ministers issued directive No. 1049-542 ordering OKB-23 to develop a high-altitude long-range bomber powered by four Dobrynin VD-5 turbojets. The aircraft bore the in-house designation 2M, alias 'aircraft 28' (VM-28) or *izdeliye* 28. It was designed to carry 5 tons of bombs over a 12,500-km (41,010-mile) distance; the 'customer' specified the maximum flight altitude over the target as 17,300 m (56,760 ft) and the top speed as 940-970 km/h (580-600 mph). Calculations showed that to achieve this performance the aircraft had to have a take-off weight around 185 tons (407,850 lb), including a maximum fuel load of 107 tons (235,890 lb), part of which would be carried in drop tanks.

Originally the 2M was similar in layout to the M-4; the wing span was 48.5 m (159 ft 1½ in), overall length 50.0 m (164 ft ½ in) and the wing area was estimated at 320-340 m² (3,440-3,656 sq. ft). The bomber had a crew of six. The 24-ton maximum ordnance load included such items as 250-kg (551-lb) FAB-250M, 5-ton (11,020-lb) FAB-5000M and 9-ton (19,840-lb) FAB-9000M high-explosive bombs (*foo**gahs**naya* ***avia**bom**ba*), 6,000-kg (13,230-lb) BRAB-6000 armour-piercing bombs (*brone**boy**naya* ***avia**bom**ba*), AMD-2M, Desna and A-2 anti-shipping mines and 450-mm (17.7-in) Type 45-36AV torpedoes. For self-defence the aircraft was provided with six 23-mm cannons, the ammunition supply being 125 rounds per gun for the dorsal and ventral barbettes and 400 rpg for the tail barbette.

The final configuration, which reached the full-scale mock-up stage and was reviewed by an Air Force commission in January 1953, envisaged placing all four engines in underwing nacelles on sharply swept pylons. Council of Ministers directives required the 2M to begin State acceptance trials first in May 1954, then in June 1955, but on 16th October 1954 the government pulled the plug on the project. The CofM directive issued that day said:

'Due to the inadequate range (7,700 km [4,780 miles] *of the 2M high-altitude long-range bomber designed by Comrade Myasishchev and considering that the Ministry of Aircraft Industry has received new assignments involving modification of the M-4 bomber with a view to obtaining a range of up to 14,000 km* [8,700 miles], *as well as construction of an experimental compound bomber with a range of 13,000 km* [8,070 miles] *and a service ceiling of 14,000-15,000 m* [45,930-49,210 ft], *[...] the proposal to terminate all further design and construction work on the 2M high-altitude long-range bomber*



A cutaway drawing of the ultimate configuration of the 2M.

put forward by the Ministry of Aircraft Industry, the Ministry of Defence and the Ministry of Agricultural Machinery is hereby accepted.'

The reference to the Ministry of Agricultural Machinery sounds a bit wild but is explained by the fact that after World War Two this ministry was responsible not only for tractors and ploughs but also for the production of various weaponry and ordnance! (This is reminiscent of a Russian fairy tale where the main character is fooled into planting dragon's teeth in a field instead of seeds, and a hostile army grows out of the earth which he then has to fight!)

The provisional specifications of the VM-28 (2M) are given in Table 4 on page 35.

M-29 airliner and military transport aircraft projects (M-6P/M-6T, VM-29, *izdeliye* 29)

In the mid-1950s the need arose for new heavy military airlifters to satisfy the needs of the Soviet Union's rapidly developing airborne forces (VDV – *vozdooshno-desahntnyye voyskah*). A joint Communist Party Central Committee/Council of Ministers directive issued in 1956 required OKB-23 to develop airliner and transport derivatives of the 3M bomber (described later in this chapter).

About the same time, OKB-156 received a similar task, commencing development of the 'aircraft 95T' military transport and the 'aircraft 95P' airliner based on the Tu-95. However, the approach taken by the two design bureaux was rather different. Whereas the fuselage contours of the Tupolev designs were almost identical to those of the original Tu-95 *sans suffixe* (*Bear-A*) which had mid-set wings, the Myasishchev OKB opted for a more advanced low-wing layout with an all-new fuselage from the outset. (The Tupolev OKB eventually arrived at the same solution when evolving the Tu-114 Rossiya (Russia; NATO reporting name *Cleat*) long-haul airliner from the Tu-95.)

The fuselage of the Myasishchev transport/airliner had an unusual 'double-bubble' cross-section with a larger upper lobe; this allowed the task of maximising usable internal volume to be reconciled with the need to retain maximum structural commonality with the bomber, thereby keeping unit costs down. (The Boeing Company used the same principle when deriving the C-97 Stratofreighter and the Model 377 Stratocruiser airliner from the B-50 Superfortress bomber.) The upper and lower lobe diameter was 4.2 m (13 ft 9¾ in) and 3.0 m (9 ft 10⅛ in) respectively. Thus the airliner variant accommodated up to 250 passengers with a high degree of comfort (plus galleys and lavatories) on the upper deck, leaving the lower deck free for baggage, fuel tanks and equipment bays, while the military transport version could carry bulky vehicles as well as personnel and offered a

Above: The captain's instrument panel on the 'aircraft 28' mock-up.

Above: The co-pilot's instrument panel and engine instrument panel on the 'aircraft 28' mock-up.

A display model of the M-29 (M-6P) airliner. The symbolic registration CCCP-Л1956 (SSSR-L1956 in Roman transliteration) alludes to the year of design.

paradropping capability thanks to a large cargo door/ramp on the forward fuselage underside and a second paradropping hatch on the aft fuselage underside *à la* Douglas C-124 Globemaster II.

The ADP project of the transport/airliner developed under the programme code ***tem**a **dva**dtsat' **de**vyat'* (Subject 29) was completed in 1956. The aircraft itself was referred to in specific documents under various designations – M-29, VM-29, M-6P (*passa**zheer**skiy [samo**lyot**]* – airliner) and M-6T (***trahns**portnyy [samo**lyot**]* – transport aircraft). Some sources indicate the transport version was to be designated M-6D (*de**sahnt**nyy [samo**lyot**]* – troopship). Different project versions differed in wing anhedral angles and the number of wing fences, although generally the wings, tail unit, landing gear and powerplant were almost identical to those of the 3M. The layout of the flightdeck remained unaltered by comparison with the *Bison*.

The project was terminated along with the other projects OKB-23 had running when the design bureau was closed down in the autumn of 1960 as a result of changing government policies (and very probably behind-the-scenes action by the chief competitor, the Tupolev OKB).

Long-range torpedo-bomber version of the M-4 *Bison-A*

Separate State acceptance trials of the M-4's anti-shipping armament took place in late 1956 and were completed in December. The aircraft in question was the second prototype M-4 ('aircraft DM'), by then serialled '101 Red'. Test missions were flown from Zhukovskiy and from Kirovskoye airbase on the Crimea Peninsula on the Black Sea; the test crew included project test pilot Vavilonov, navigator Makarov, radar operator Kryukov and radio operator/gunner Zulutdinov.

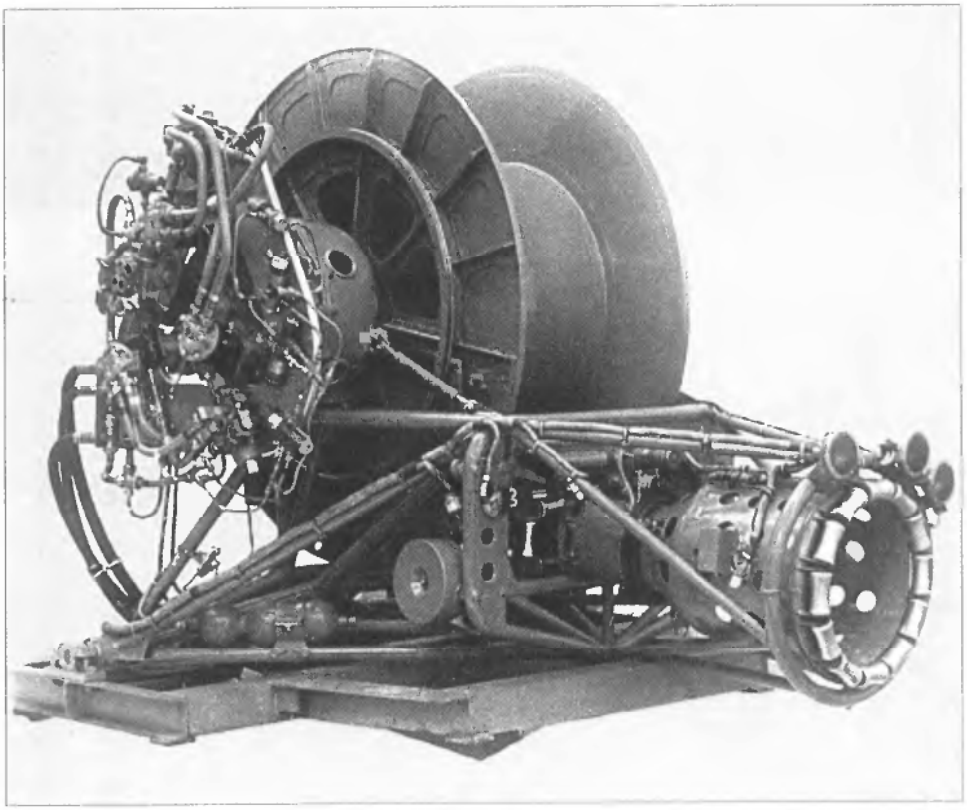
For each mission the bomber was alternatively armed with six RAT-52M torpedoes or six anti-shipping mines of assorted types (IGDM, APM, Leera (Lyre), Serpey or AMD-2M). The munitions were carried internally on KD-4M racks. With 5% fuel reserves, maximum range in minelayer/torpedo-bomber configuration at a cruising speed of 800 km/h (496 mph) was 8,450 km (5,250 miles); the service ceiling over the target did not exceed 13,100 m (42,980 ft), increasing to 15,300 m (50,200 ft) at the end of the mission after the torpedoes had been dropped.

The RAT-52 (*ra**ket**naya a**viatsi**onnaya tor**ped**a* – rocket-propelled air-dropped torpedo, 1952 model) deserves special mention. This weapon was conceived as a homing torpedo, but the guidance system was considered too complicated and was deleted in the production version. The torpedo weighed 627 kg (1,382 lb) and had a 243-kg (535-lb) warhead.

Before dropping the torpedo the navigator set the travel depth at 2-8 m (6½-26 ft), charged the torpedo's condensers and began the run-in to the target as usual. At the proper moment the bomb sight automatically dropped the weapon. One second later a small propeller-shaped drag parachute deployed and the torpedo descended vertically, dropping fast like a bomb. The main parachute deployed at 500 m (1,640 ft), reducing the descent speed. It separated after the torpedo entered the water; then special foreplanes were brought into play to turn the torpedo horizontally and were jettisoned immediately afterwards. Next, the solid-fuel rocket motor fired and the torpedo accelerated to 58-68 kts (107-130 km/h); by comparison, conventional torpedoes with steam turbines could not travel faster than 40-45 kts. Time from drop to impact was only about 35 seconds, which left the target no time for evasive action.

The weapon's chief shortcoming was the rocket motor's short burn time resulting in a range of only 550-600 m (1,800-1,970 ft) which took the bomber uncomfortably close to the target (within range of the ship's air defences). On the other hand, the torpedo could be dropped from any altitude between 1,500 m (4,920 ft) and the aircraft's service ceiling at a speed of up to 800 km/h, which was of particular importance for jet torpedo-bombers. Live drops at the Soviet Navy test range near Feodosiya showed a 'kill' probability of 17-38% in a single-torpedo attack.

The trials were deemed successful but the torpedo-bomber version of the M-4 did not enter production because of the changing attitude towards this class of combat aircraft – torpedo-bombers were already considered outmoded at the time.



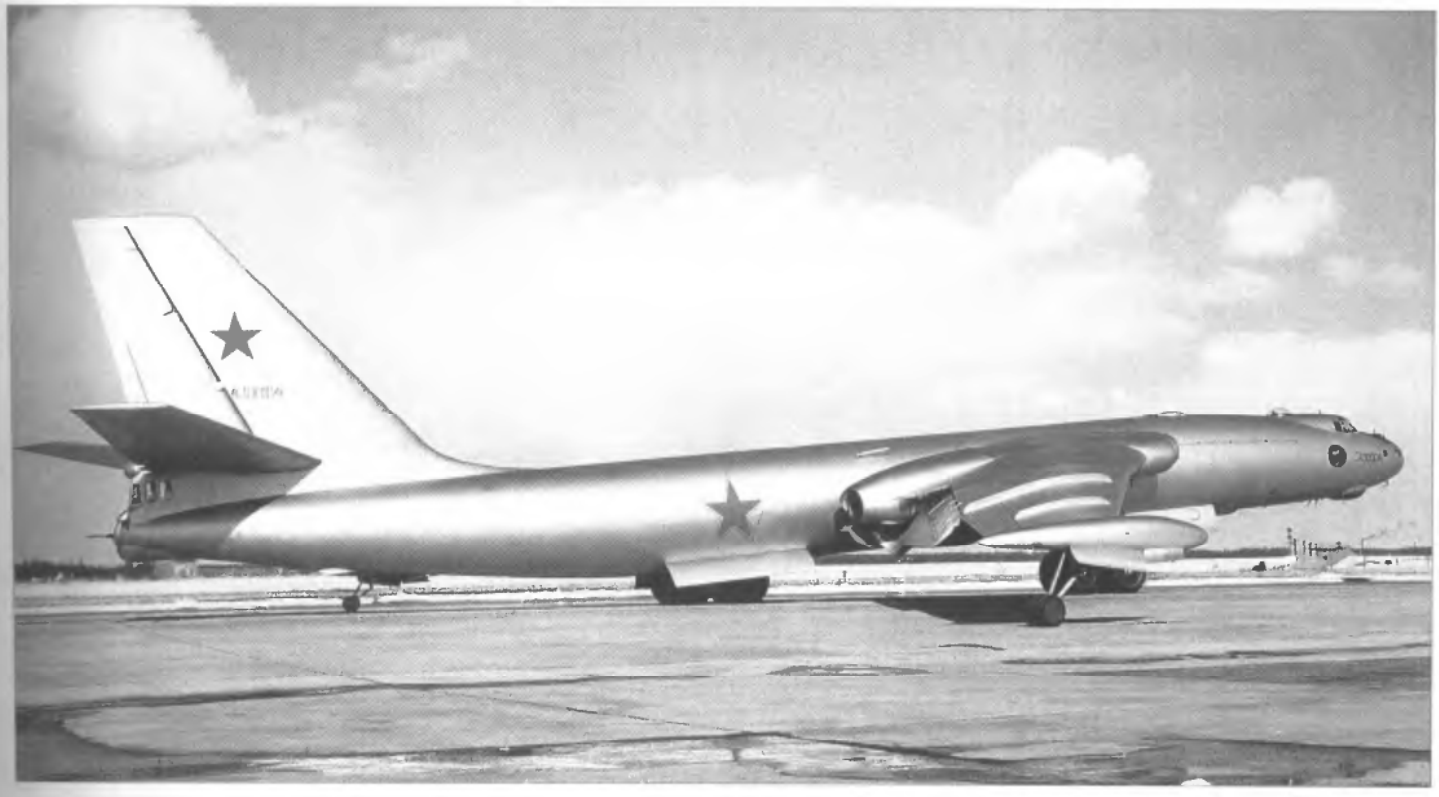
The KAZ hose drum unit (HDU) which could be fitted to an M-4, turning it into an M-4-2 tanker. Note the signal lights on the drogue indicating fuel transfer status to the crew of the receiver aircraft.

M-4-2 (M-4-II) *Bison-A* flight refuelling tanker

In-flight refuelling (IFR) was a sore spot for the Soviet Air Force. While fighters and tactical bombers had to do without (until the 1980s anyway), extending the range of strategic bombers by in-flight refuelling (IFR) immediately became a high-priority task in the post-war years.

After the closure of his OKB-21 and the end of his endeavours to build fighters for the VVS, Semyon M. Alekseyev established a new design bureau – OKB-918. This new company was tasked with more humble but nevertheless important matters associated with aviation, including development of IFR systems. Pretty soon Alekseyev found a customer for these – the Myasishchev OKB.

As already noted in the previous chapter, the Soviet Air Force was dissatisfied with the M-4's short range which was only 9,800 km (6,090 miles) instead of the required 11,000-12,000 km (6,830-7,450 miles) – with bombs! The fact that the competing Tupolev boasted a range in excess of 13,000 km (8,075 miles) certainly did not help. To add insult to injury, the Tupolev OKB was already using the wingtip-to-wingtip IFR system



Above: **The first production M-4 (c/n 4300104), still lacking a serial, shortly after outfitting for IFR system trials. The tip of the refuelling probe can just be glimpsed over the nose.**

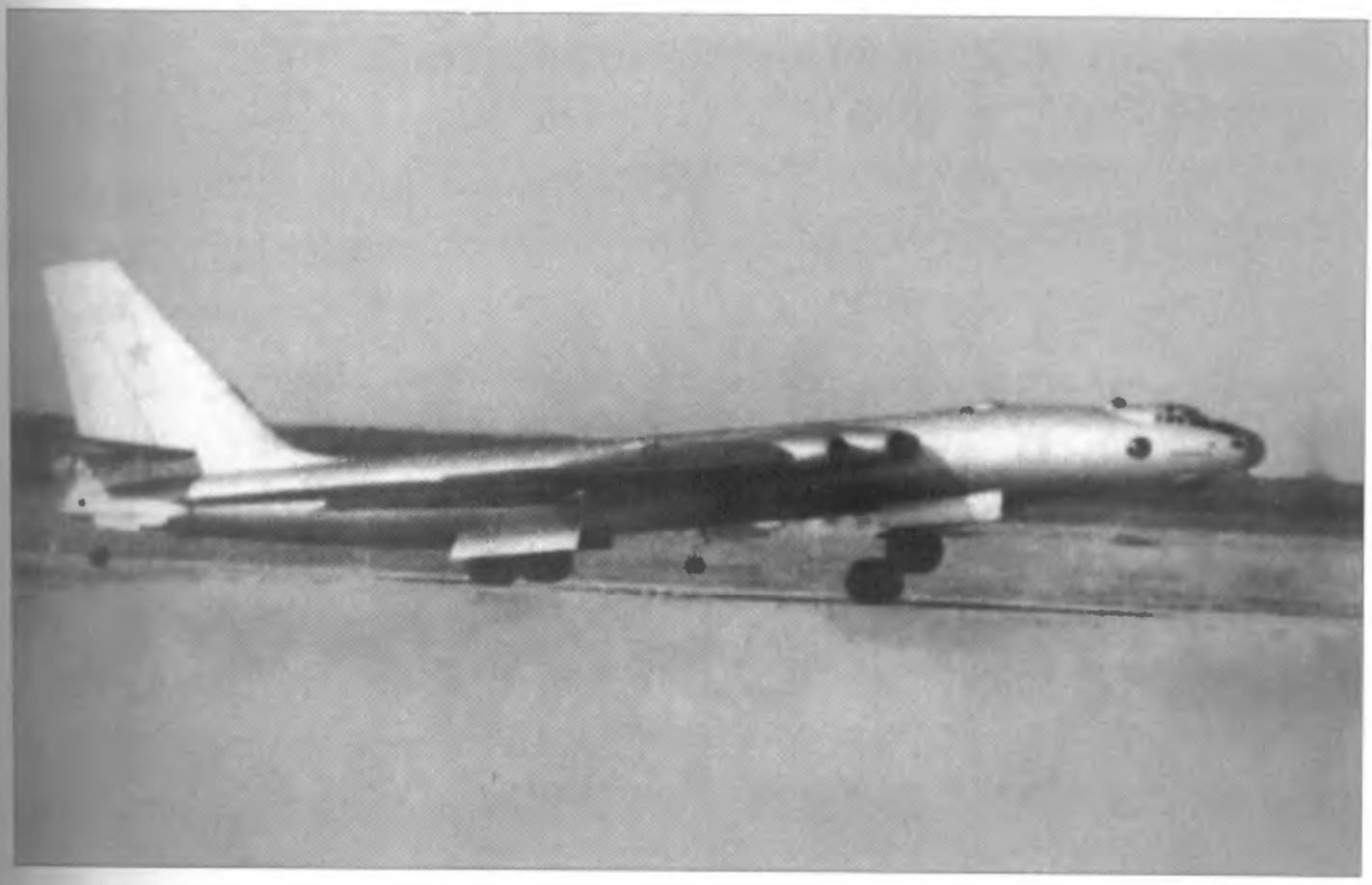
developed by LII test pilots Igor' Shelest and Viktor Vasyanin in 1948 for its Tu-4 and Tu-16 bombers. (The system worked like this: the tanker deployed a hose stabilised by a drogue parachute from one wingtip and the receiver aircraft placed its opposite wingtip over the hose. Then the hose was rewound until the fitting at the end engaged an underwing receptacle. The receiver aircraft accelerated so that the hose formed a loop and rotated the receptacle, opening a valve, whereupon fuel transfer could begin.) Since the Tupolev and Myasishchev bureaux were barely on speaking terms, Vladimir M. Myasishchev could not use the wingtip-to-wingtip system for his M-4 because the influential Andrey N. Tupolev would stir up trouble. That left OKB-23 with just one option – to adapt the *Bison* for the tanker role so that it would support the operations of sister aircraft.

The same aircraft in flight, bearing the serial '85 Red'; the c/n has been altered to '4300' by military censors. The refuelling probe and associated pipeline conduit are clearly visible. This photo has often been incorrectly captioned as showing the first prototype.

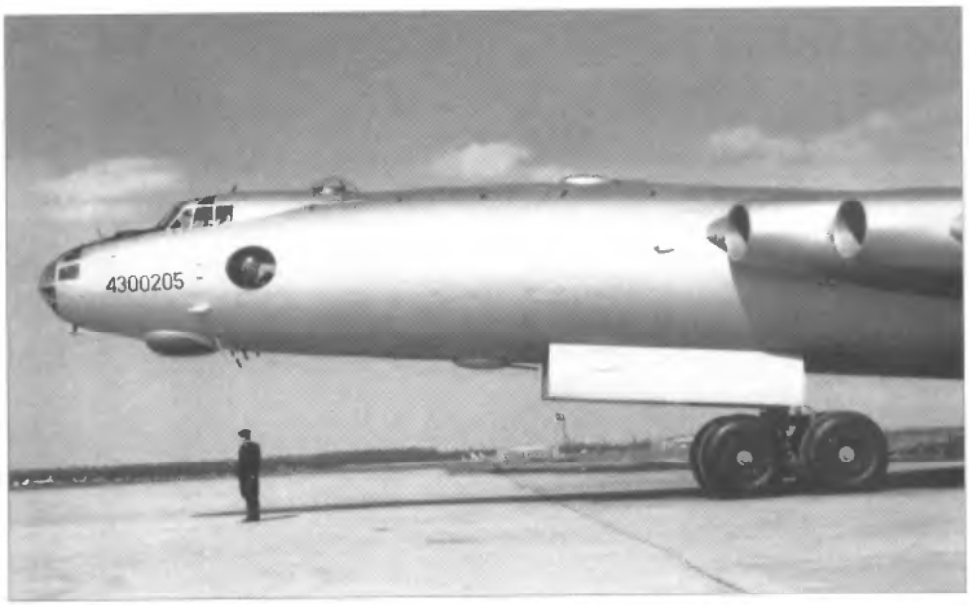
Above: The second prototype M-4, now serialled '101 Red', pictured during State acceptance trials of the mine and torpedo armament in late 1956. The aircraft's high tactical code is noteworthy.

Another view of '101 Red'; note the absence of the star insignia on the fuselage. A camera pack appears to be fitted instead of the tail guns.

Above: Front view of M-4 '101 Red' (c/n 4300003) during the anti-shipping armament trials.



This picture of M-4 '101 Red' at the moment of take-off shows how the nose gear's bogie tilting feature worked.



Above: Still unserialled, the second production M-4 was converted into the prototype of the M-4-2 flight refuelling tanker. Successful trials with this aircraft later led to all surviving *Bison-As* being modified into tankers.

Left: The forward fuselage of the M-4-2 tanker prototype seen at Zhukovskiy during tests.

Below: The first (c/n 4300104) and second production M-4s parked together. The first aircraft was earmarked for conversion as the receiver aircraft prototype; it is seen here prior to fitment of the refuelling probe and the application of a scheme but already sporting large photo-calibration markings on the rear fuselage.

Above: The tanker prototype in flight with the drogue deployed. Again no serial is carried (and the c/n appears to have been retouched away) but the aircraft sports photo-calibration markings.

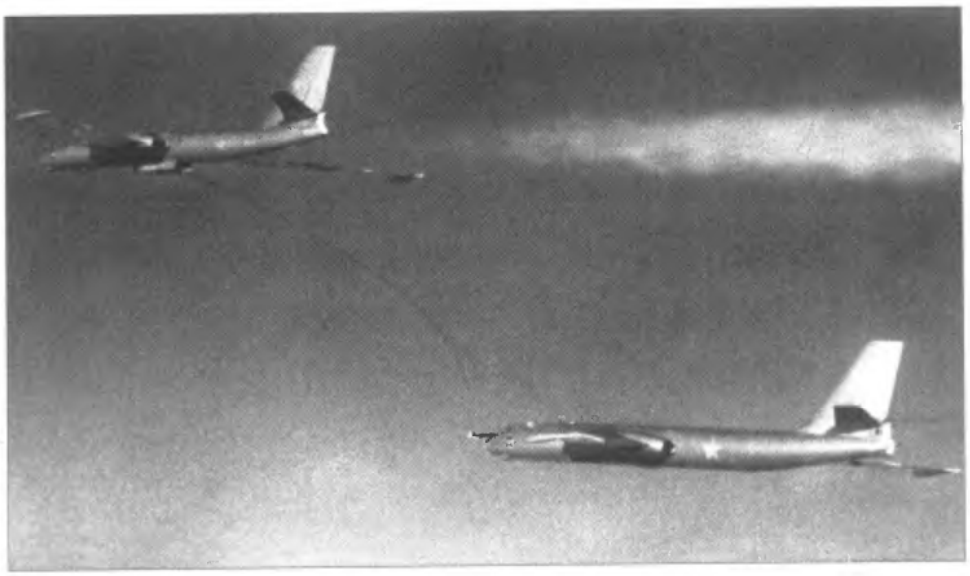
Busy scene at the OKB's flight test facility, with probe-equipped M-4 '85 Red' (c/n 4300104) in the foreground and the tanker prototype '71 Red' (c/n 4300205) beyond. The Tu-4 in the background is probably the *izdeliye* SUR testbed (c/n 230322) for the M-4's SUM JATO booster. The third *Bison-A* must be c/n 4300306.

Above: '77 Red', a 'production' M-4-2 tanker serving with the 1230th APSZ (Air Refuelling Regiment) at Engels-2 AB. The double number of flush aerials in the fi for the short-range radio navigation system (SHORAN) is the tanker's recognition feature.

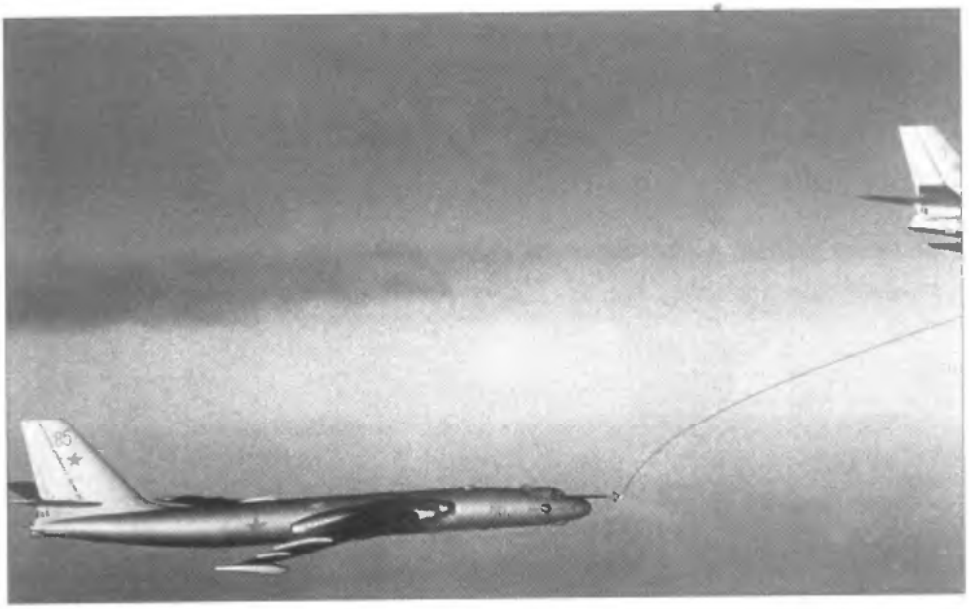
Head-on view of an M-4-2 at Engels-2 AB.

Above: '61 Red' (c/n 6303134), the last-but-one *Bison-A*, also became an M-4-2, like all her surviving sister ships.

Another view of M-4-2 '61 Red' (c/n 6303134).



Above and below: M-4-2 '71 Red' (c/n 4300205) and M-4 '85 Red' (c/n 4300104) leave contrails across the sky as the latter aircraft takes on fuel during a high-altitude test flight.



A formation of three M-4s makes a flypast during the Aviation Day parade at Moscow-Tushino in 1956.

Hence OKB-918 developed a probe-and-drogue IFR system (similar to the one invented by the British company Flight Refuelling Ltd) for the M-4. The tanker's bomb bay accommodated fuel tanks and a hose drum unit (HDU) – a powered drum with a tilting hose guide frame and a fuel transfer hose about 50 m (164 ft) long terminating in a stabilising drogue. This assembly was known as the KAZ (***kom**pleksnyy agre**gaht** za**prahvki***); the most proper translation would be 'self-contained refuelling pack', since the aircraft could be easily reconverted to bomber configuration by removing the HDU. The system was operated by the tail gunner whose workstation commanded an unobstructed view of the rear hemisphere.

The drogue's shape and weight were carefully chosen to provide optimum stabilisation in the turbulent slipstream. The HDU deployment/stowing actuator, the drum drive and the fuel transfer pumps were hydraulically operated; the drum featured an emergency brake. The delivery rate was about 2,000 litres (440 Imp. gal.) per minute.

The receiver aircraft featured a long probe tipped with a special adapter atop the extreme nose. The probe was telescopic and was 'fired' pneumatically into the drogue, activating a locking mechanism, whereupon fuel transfer began.

To verify the new system OKB-918 converted an IL-28 bomber built by the Voronezh aircraft factory No. 64 ('01 Red', c/n 24021[illegible]) into a makeshift 'tanker trainer'. An experimental winch emulating the HDU was installed in the bomb bay, paying out a 5-mm (3/16 in) steel cable with a drogue of 640 mm (2 ft 1¼ in) diameter to a point 42 m (137 ft) beyond the bomber's tail. Initially a 36-kg (79-lb) unstabilised drogue was used; after the first four flights it was replaced with a drogue incorporating a stabilising device. The aircraft worked with the tenth production Gor'kiy-built MiG-19 *sans suffixe/Farmer* ('10 Red', c/n 59210110), converted by late 1957. This fighter had no fewer than [illegible] dummy refuelling probes (one ahead of the windscreen and three on the port wing because the best location had to be determined experimentally.

Apart from the IFR system as such, there were numerous complex issues to deal with; these included ensuring the rendezvous between the tanker and receiver aircraft a long way from the base and in various visibility conditions, ensuring reliable communication between the two and sufficiently rapid transfer of large amounts of fuel, etc. Engineer L. M. Rodnyanskiy was in charge of the programme at OKB-23.

Real-life tests of the probe-and-drogue IFR system on the *Bison* began in 1955

Above: Gone to grass. Still outwardly intact, M-4-2 '63 Red' (c/n 6301518) sits at Engels-2 AB following retirement, awaiting disposal. This aircraft was actually the second prototype M-4-2, used to test the definitive version of the KAZ hose drum unit.

Another view of '63 Red'. Note the white colouring of the fin trailing edge and rudder which was part of the M-4's standard 'anti-nuclear' colour scheme protecting the airframe from the flash of a nuclear explosion.

second production M-4 (c/n 4300205) was converted into the prototype of the tanker version, while the first production aircraft was retrofitted with a refuelling probe atop the extreme nose; this particular example is sometimes referred to in the aviation press as the M-4A. Shortly after conversion both aircraft gained large red serials on the nose and tail; the tanker was serialled '71 Red' and M-4 c/n 4300104 was '85 Red'. (Annoyingly, on many photos of these two aircraft the construction numbers boldly stencilled on the nose have been retouched by military censors so that the aircraft appear to be marked '4300' or '43001' instead of their proper c/ns!) Both aircraft also sported large photo calibration markings on the rear fuselage.

After a lengthy training period test pilot Nikolay I. Goryainov performed the first successful refuelling of an M-4 by a sister aircraft. In the course of the manufacturer's flight tests the receiver aircraft made 36 flights totalling 77 hours 7 minutes, while the tanker logged 63 hours 21 minutes in 32 test flights.

On 28th April 1956 the two aircraft were turned over to GK NII VVS – a year later than intended. Actually the State acceptance trials began after a further five-month delay on 27th September 1956 but were halted soon afterwards due to numerous technical problems which had to be rectified. Dangerous situations occurred frequently during the trials. There were several cases when the fuel transfer hose snapped; at best the drogue remained impaled on the probe and at worst the remnant of the hose whipped around the horizontal tail, which could result in damage to the elevators and loss of control. As the two aircraft broke contact the receiver aircraft was liberally doused with the kerosene remaining in the hose and the crew couldn't see anything for a few moments, etc. (It is as well to add at this point that 'hitting the tanker' was a lot easier on the later 3M *Bison-B* and 3MD *Bison-C*. These aircraft had a longer and more pointed nose; consequently the airflow around the nose was much smoother, making the hose and drogue more stable.)

On 26th July 1956 the M-4's newly-acquired IFR capability was shown off *urbi et orbi* during the traditional air fete held annually at Moscow's Tushino airfield. The flypast included the tanker and receiver prototypes which passed over the crowd in a refuelling formation.

Later, two more *Bison-As* were modified for the purpose of holding Stage B of the State acceptance trials. M-4 '63 Red' (c/n 5301518) was fitted with an IFR probe while M-4 c/n 5301619 (tactical code unknown) became the second tanker prototype. This time the system was a different one, developed in-house by OKB-23. The manufacturer's flight tests, which were completed in February 1957, included a mission involving two fuel top-ups. Receiving 35 tons (77,160 lb) of kerosene en route to the target, the bomber rendezvoused with the tanker again on the way home to fill up with another 24 tons (52,910 lb) of fuel; as a result, the range attained was an impressive 14,500 km (9,006 miles)! Stage B, which ended in June 1958, again revealed a number of shortcomings, unreliable operation of the HDU's servo system and the IFR probe being the most serious ones.

Starting in the late 1950s, the M-4 bomber fleet was progressively converted for the tanker role. Officially designated M-4-2 (sometimes rendered as M-4-II), these tankers worked with 3M and Tu-95 bombers. Most of the Tu-22 *Blinder* medium bombers were retrofitted with refuelling probes as well, while Tu-22M2 *Backfire-B* (and some Tu-22M3 *Backfire-C*) 'swing-wing' medium bombers/missile strike aircraft had them from the outset; however, the probes were removed from the Backfires in compliance with the SALT II strategic arms limitation treaty signed on 19th July 1979 which imposed a limit on the bombers' range.

The M-4-2's powerplant consisted of four Zoobets RD-3M-500A turbojets rated at 9,500 kgp (20,940 lb st); all armament was deleted. The maximum transferable fuel load was 40 tons (88,180 lb).

M-4 *Bison-A* development aircraft with IFR capability

As noted earlier, M-4s with the c/ns 4300104 and 5301619 served as testbeds for the probe-and-drogue IFR system developed jointly with Alekseyev's OKB-918. A telescopic refuelling probe was installed ahead of the flightdeck windscreen, slightly offset to port; it featured an adapter providing a secure and fuel-tight connection between the probe and the tanker's drogue. An external fuel line conduit ran along the port side of the forward fuselage from the probe to a spot just aft of the forward crew cabin where the forward fuselage fuel cells were located.

3M *Bison-B* long-range bomber (M-6, *izdeliye* 36)

By the mid-1950s it had become obvious that the Soviet Air Force would have to field both the M-4 and the Tu-95 rather than one of them as originally planned. The two bombers complemented each other; while the *Bison* offered higher speed and a higher warload, the *Bear* possessed longer range. (This goes to show that the Soviet Union had not succeeded in creating a true equivalent of the Boeing B-52 as far as the combination of speed, service ceiling and range was concerned. On the other hand, the Soviet aircraft industry was then in the lead as far as development of powerful jet engines was concerned; it was the lack of a suitable turbojet rated at more than 6,000 kgp (13,200 lb st) for take-off that forced the Boeing Company to use eight 5,000-kgp (11,000-lb st) Pratt & Whitney J-57s for the B-52.)

In April 1954 Minister of Aircraft Industry Pyotr V. Dement'yev reported to the CofM Presidium as follows:

'Until recently the general belief was that a bomber powered by state-of-the-art turbojet engines cannot achieve a range of more than 9,500-10,000 km [5,900-6,210 miles]*; therefore [aircraft designers] strove to attain a range of 14,000-15,000 km* [8,700-9,320 miles] *by using turboprop engines. To this end Comrade Tupolev has envisaged a powerplant of four Kuznetsov TV-12 turboprops for his "aircraft 95" bomber prototype, which is to give the aircraft an effective range of 16,000-16,500 km* [9,940-10,250 miles]. *[...]*

'The Ministry of Aircraft Industry believes that creation of bombers with a 14,000-km range should be possible using turbojet engines as well. It has tasked the TsAGI and TsIAM research institutes with reconsidering current views (sic – *Auth.*) *and finding practicable means of maximising the range of turbojet-powered heavy bombers jointly with the chief designers [of the aircraft and engine design bureaux].*

'Building on experience accumulated both in-country and abroad, as well as on research done by TsAGI, TsIAM and the OKBs, it has been established that there is currently the possibility to significantly improve the fuel efficiency of turbojet engines, reducing specific fuel consumption by 20-25%, [...] and to improve the aerodynamics of aircraft, thereby substantially increasing range.

'In accordance with these conclusions Chief Designer Comrade [Vladimir A.] Dobrynin has offered to evolve the fuel-efficient VD-7 engine with a maximum take-off rating of 11,000 kgp [24,250 lb st] *and a cruise SFC of 0.85 kg/kgp·hr from the existing VD engine.*

'According to Tupolev OKB calculations the high-altitude long-range bomber currently under construction (this must be the second prototype Tu-95 – *Auth.*) *is equipped with four VD-7 engines the aircraft will have the following performance:*

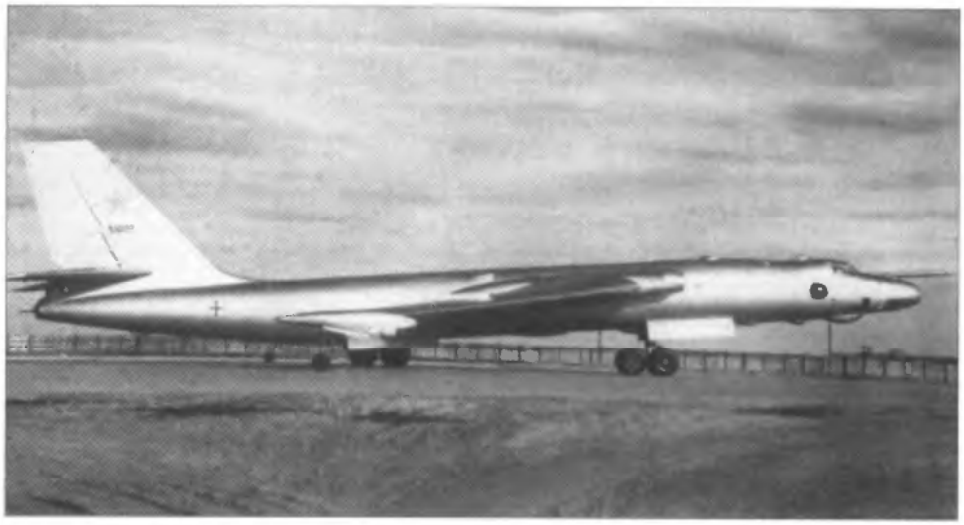
- effective range: 13,500-14,000 km [8,390-8,700 miles]*;*

- service ceiling above the target: 13,500-14,000 m [44,290-45,930 ft]*;*

- top speed: 920-950 km/h [571-590 mph]

'Comrade Myasishchev has likewise performed calculations as to the possibility of installing four VD-7 engines on the "aircraft 4" bomber instead of the current AM-3s. The re-engined aircraft would have the following performance:

Above: **The first prototype of the 3M (alias M-6), a much-improved version of the M-4 (c/n 5320101), at the OKB's flight test facility. The distinctive thimble shape of the nose with a radome in lieu of the *Bison-A*'s characteristic extensive glazing is clearly visible.**



Right: **Another view of the 3M prototype. Note the cross-shaped photo-calibration markings on the forward and aft fuselage.**

- effective range: 13,500-14,000 km;

- service ceiling above the target: 13,500-14,000 m;

- top speed: 950-1,000 km/h [590-621 mph].

'Additionally, Comrades Tupolev and Myasishchev propose equipping the aircraft with an in-flight refuelling system, which would extend their range to 16,000-17,000 km [9,940-10,560 miles].'

True enough, the fuel efficiency of the Mikulin AM-3A and Zoobets RD-3M turbojets left a lot to be desired. Hence OKB-23 had closely followed the VD-7 turbojet's development progress almost from the inception of the 'aircraft M' bomber project. When the VD-7 commenced bench running, Vladimir M. Myasishchev firmly made up his mind to secure this engine for his bomber. As the prototypes accumulated engine hours on the test rigs, proving their viability and allowing the VD-7's reliability to be estimated, the airframers at OKB-23 started designing new wing root sections and engine bays tailored to the Dobrynin turbofan for the M-4. The *Bison* re-engining programme was coded ***tema*** *tridtsat' shest'* (Subject 36).

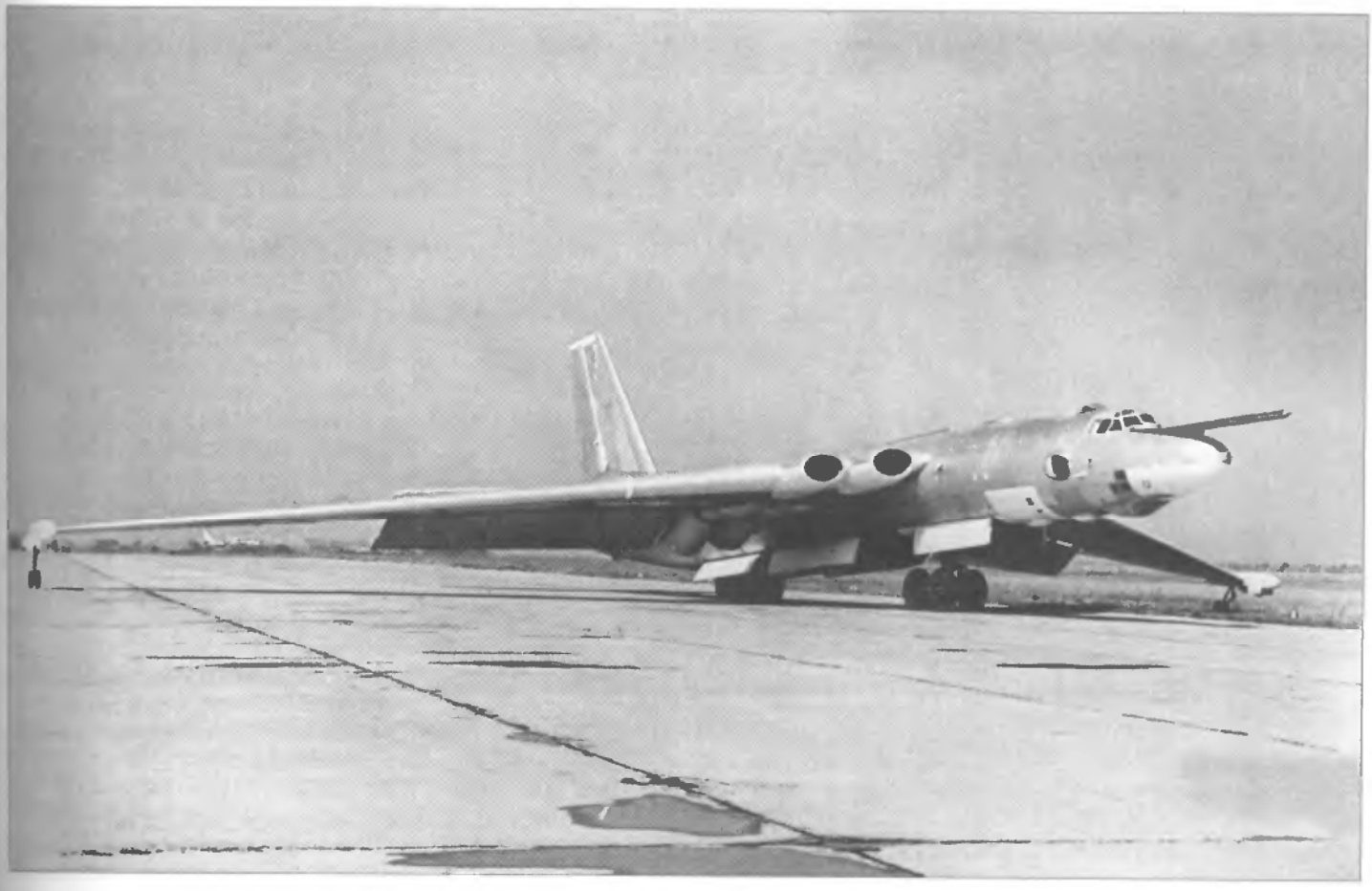
The programme was formally launched in July 1954 when the Council of Ministers let loose with a directive ordering development of the M-6 bomber powered by VD-7 turbojets. Klimov VK-9 turbojets and Mikulin AM-13 coupled turbojets offering comparable overall performance were envisaged as alternative powerplants in case the VD-7 did not come up to scratch. For a while the Myasishchev OKB even considered installing TV-12 turboprops which would give the M-6 a range in excess of 14,000 km.

The different dimensions of the VD-7 brought about a redesign of the bomber's monobloc central structural assembly consisting of the 23-m (75 ft 5½ in) centre fuselage section built integrally with the wing centre section having a 20-m (65 ft 7½ in) span. Known colloquially as the *krest* (cross) for its cruciform shape, this huge sub-assembly was outfitted separately during construction and delivered to the final assembly line with all systems and equipment in place.

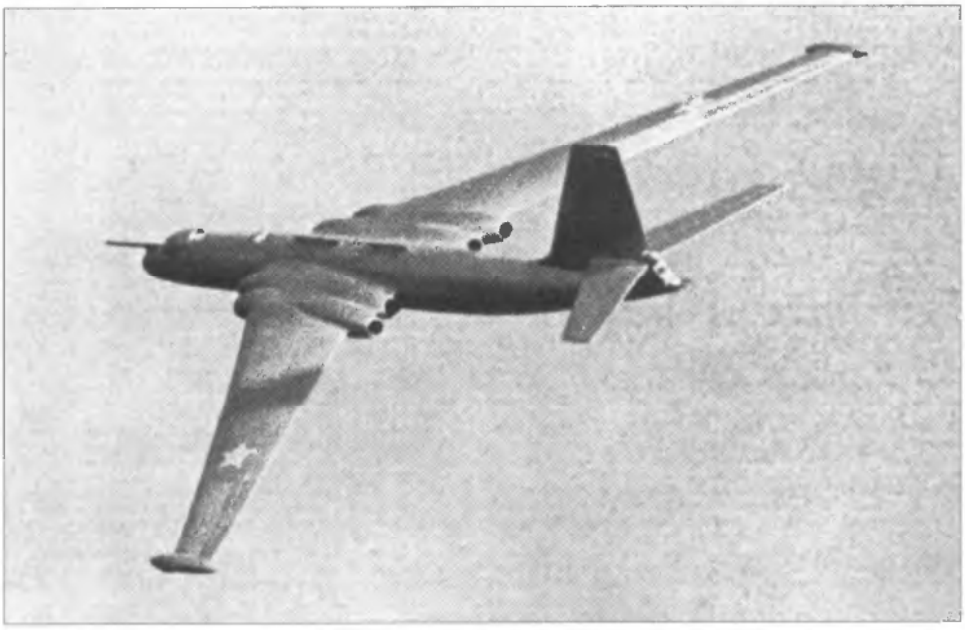
All the other units and sub-assemblies attached to this 'cross' also underwent a major revision. The new bomber featured new outer wings giving greater span (the landing gear track was increased accordingly) and a larger wing area. Wing aerodynamics were improved by eliminating the trailing edge kink which created vortices and hence drag; the wing camber was changed and both boundary layer fences on each wing were moved inboard considerably. The fixed-incidence dihedral tailplanes gave way to all-new variable-incidence stabilisers featuring greater span (15.2 m/49 ft 10½ in) and zero dihedral.

The fuselage nose ahead of the flightdeck glazing was extended by 90 cm (2 ft 11½ in) and recontoured, receiving a thimble-like shape. The characteristic nose glazing of the navigator's station and the chin radome vanished, giving way to a larger radome blended smoothly into the nose contour. The navigator/bomb-aimer now sat aft of the radar instead of above and ahead of it; thus he had no forward or upward visibility, having to make do with three small windows on each

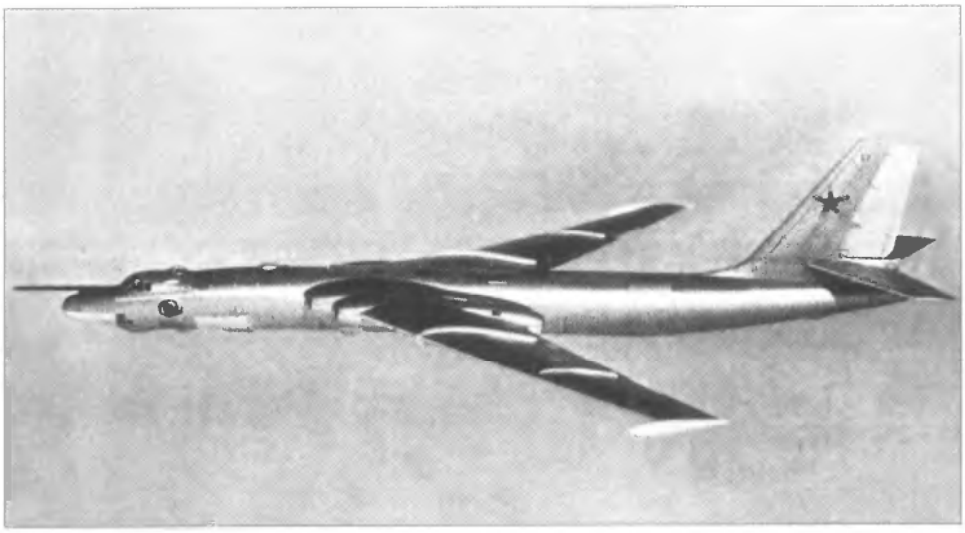
Above: The 3M prototype pictured during taxying trials at Zhukovskiy.
Below: The prototype takes off with two 6,500-litre (1,430 Imp. gal.) drop tanks under the wing roots. The Dobrynin VD-7 engines left a characteristic smoke trail



Above and below: A production 3M coded '54 Red' with the bomb bay doors open. The bomber variant of the *Bison-B* was built with a refueiiing probe, uniike the tanker variant which lacked iFR capabiiity.



Above: A 3M makes a banked turn, showing off the zero-dihedral tailplanes introduced on this version and the tandem ADF strake aerials on the fuselage.



Above: An air-to-air of '52 Red', a 3M powered by Dobrynin VD-7 or VD-7B engines; this version was also known as the 3MN-1.

3M c/n 6320401 in cruise flight. This picture gives a good view of the 6,500-litre drop tanks with vertical stabilising fins at the rear.

side of the nose and a ventral optically flat sighting window built into a small teardrop fairing. As already mentioned, a welcome side effect of the new nose shape was that the IFR procedure became easier, as the tanker's drogue was more stable. Unlike the modified probe-equipped M-4s described earlier, the refuelling probe was placed on the aircraft's centreline.

The issue of reducing the bomber's structural weight was addressed as well. Operational experience with the M-4 made it possible to revise structural strength standards used in bomber design. It turned out that the engineers had played safe, assuming the operational loads would be higher than they actually were and incorporating excessive strength into some airframe components which ended up being overweight. Now, armed with this knowledge, the structural strength department made new calculations. The result was a weight saving of no less than 6,500 kg (14,330 lb) as compared to the M-4; the landing gear alone accounted for 1,800 kg (3,970 lb) of the saved weight, but the greater part of the saving was distributed between the wing spars and stringers, fuel cells and the lighter engines.

Updates were made to the bomber's systems and equipment. For instance, the flight control system incorporated yaw damper. An electronic countermeasures (ECM) suite was added, comprising an SPS-2 active jammer, three chaff dispenser modules in the mainwheel well for jamming ground-based air defence (AD) radars and two more chaff dispensers in the rear fuselage for jamming the fire control radars of enemy fighters.

The avionics and equipment included an AP-15 autopilot, main and back-up ARK-5 ADFs, RV-2 and RV-17 radio altimeters, an SPI-1 long-range radio navigation (LORAN) system, an SRZO-2 Khrom-Nikel' (Chromium-Nickel; NATO code name *Odd Rods*) IFF interrogator/transponder (*samo**lyot**nyy raho**lokatsi**onnyy za**pros**chik-ot**vet**chik*) and an SRO-2 Khrom IFF transponder, an SP-5 automatic landing approach system (*[appa**ratoora] sle**poy po**sahd**ki* – blind landing equipment) and a DAK-DB remote celestial compass (*distantsi**onnyy a**strokom**pas*). The navigation/attack radar was the same RBP-Rubidiy-MM II unit as used on the original M-4; the Soviet avionics industry could not offer anything else at the time.

The maximum ordnance load remained unchanged at 24 tons (52,910 lb). The crew, however, was reduced to seven; the flight engineer/gunner was replaced by an EW officer and the radio operator was eliminated, his functions going to the dorsal gunner. The reduction of the crew and the relocation of the navigator's station allowed the forward pressure cabin to be reduced in size.

Above: A 3MN-1 comes in to land, leaving a characteristic smoke trail. This view shows the position of the nose and main gear bogies in no-load condition.

The bottom line was that the redesign increased the new bomber's lift/drag ratio at the optimum angle of attack from the M-4's 17.47 (an impressive figure as it is) to an unbelievable 18.5 – an unparalleled result for an aircraft in this category.

The design changes were so extensive that the bomber could justifiably be regarded as a new aircraft. Hence the Air Force allocated a new service designation, 3M, by which the aircraft is best known. Some OKB-23 documents, however, referred to the bomber as the M-6 – the designation used in the aforementioned CofM directive.

The prototype 3M was converted from a standard late-production M-4 released by the factory in November 1955 (c/n unknown). After conversion the aircraft received a new c/n, 5320101 (ie, year of manufacture 1955, plant No. 23, Batch 01, first aircraft in the batch). The meaning of the third digit is unknown; it is a '2' on some 3Ms but most aircraft have a '0' as the third digit in the c/n. Each batch consisted of five aircraft. The c/n was usually stencilled on the nose and tail (later on the tail only) and in the nosewheel well. (Incidentally, the spurious designation 201M by which the 3M was referred to in the popular press and FAI (*Fédération Aéronautique Internationale*) documents was derived from the '201' in the prototype's c/n!)

Since flight-cleared VD-7s were still unavailable at the time (reliably functioning engines delivering a stable thrust and stable rpm could be counted on the fingers of one hand), the prototype had to be fitted with AM-3A turbojets as a stopgap measure to enable initial flight tests to begin. Piloted by Mark L. Gallai (captain) and Nikolay I. Goryainov (co-pilot), the aircraft made its first flight on 27th March 1956; the manufacturer's flight test programme continued until January 1957.

A 3M coded '36 Red' streams its triple brake parachutes after touchdown. This perspective does not give any idea of the engine type, making accurate identification (3MN-1 or 3MS-1) impossible.

Originally the 3M prototype had no tactical code but was later coded '60 Blue'.

In 1956 the factory, which was still manufacturing M-4s at the time, gradually started switching to 3M production. The first production aircraft (c/n 6320201 or 6300201) was unique in that it had a mixed powerplant with two RD-3Ms to port and two VD-7s to starboard. The VD-7s were adjusted to limit their rating so as to avoid any asymmetrical thrust, thus providing a normal throttle position and coherent flight instrument readings. You have to give credit to Vladimir M. Myasishchev who, with typical resourcefulness, devised this unconventional solution in order to speed up the trials.

The third production aircraft (c/n 6320203 or 6300203) which completed manufacturer's flight tests in September 1956 was the first 3M to feature the intended powerplant of four VD-7s. That same year Vladimir M. Myasishchev was 'promoted' to General Designer, and in 1957 he received the prestigious Hero of Socialist Labour title, the civilian equivalent of Hero of the Soviet Union.

State acceptance trials of the 3M were set to begin on 30th January 1957 but had to be postponed because of persistent problems with the VD-7 turbojets, which were prone to surging. It took almost a full year to rectify this problem, and the concluding stage of the trials could not begin until 16th January 1958. The trials involved three Batch 2 aircraft (c/ns 63*0201, 63*0203 and 63*0204); the first aircraft was used for performance and handling tests, the second machine served to put the equipment and armament through their paces and the third machine was used for IFR system verification. GK NII VVS pilots Yuriy V. Sookhov, S. M. Antonov and Neverov were the project test pilots; N. N. Belyayev and Sergey G. Dedookh also flew the aircraft. In January 1958 a production 3M (c/n 7300601, later coded '24 Red') was used to verify the ejection seats.

The 3M not only entered production but was actually included into the Soviet Air Force inventory before the State acceptance trials had even started, so acute was the need for the new bomber. Despite the huge amount of test and development work aimed at ironing out the bomber's initial problems, the factory test pilots pointed out that the 3M was quite a handful during take-off and landing. Some even voiced doubts at to whether the Air Force could master the aircraft. A special panel was formed to look into the matter – and came to the conclusion that an average-skilled crew could not cope with the 3M; the airmen needed to be real professionals with practical experience. The Air Force acknowledged this; however, since the new bomber was not produced in large quantities, finding an adequate number of highly professional pilots was no great problem.

Yet, new problems soon surfaced – and nearly wrecked the 3M's service career before it had even started. Shortly after the completion of State acceptance trials two brand-new bombers crashed fatally during pre-delivery test flights. The accidents were identical: as the nose gear bogie tilted during take-off, the aircraft pitched up sharply, stalling and crashing immediately after becoming airborne.

Again an investigative panel was hastily convened. Air Force and TsAGI representatives went on the offensive, demanding removal of the nose gear bogie tilting mechanism which, they claimed, was responsible for the crashes. The design collective of OKB-23 had a hard time defending their brainchild. Eventually, however, the aircraft was cleared completely. What had happened was this. Normally the nose gear was offloaded as wing lift increased during the take-off run, and the hydraulic tilt damper rotated the bogie, lifting its front wheels off the runway. Later there was a standing joke among *Bison* pilots that all the captain had to do at this moment was sit back, keep the rudder pedals neutral and wait for payday. However, unable to overcome ingrained habits, some pilots would haul back on the control column to initiate rotation, just as they would on a tricycle-gear aircraft. This was the fatal error; the bogie would tilt faster than it should, catapulting the nose up, and the considerable inertia of the

Due to problems with VD-7 production, many *Bison-Bs* had to be built with the old RD-3M (RD-3M-500A) or even AM-3A turbojets. This version was designated 3MS. Here a 3MS-1 (c/n 0204) just about to 'hit the tanker' shows off the Mikulin/Zoobets-engined version's identification feature – the slit-shaped accessory cooling air intakes at the rear ends of the engine nacelles.

This poor but interesting photograph shows M-4 c/n 4300104 taking on fuel from an M-4-2 over Moscow-Tushino during the 26th July 1956 air fest.

heavy forward fuselage would pitch the aircraft up into a super-stalled position.

OKB-23 never ceased working on improving the crew's working conditions. Flight-deck/workstation ergonomics and the air-conditioning system were constantly refined; a special test programme was held to find ways of reducing the psychological and physical strain during night flying. As noted earlier, a yaw damper was introduced into the rudder control circuit at TsAGI's suggestion to facilitate flying the aircraft; later, the rudder itself was reshaped on late-production bombers. Nevertheless, some shortcomings 'seen from the cockpit' survived until the very last *Bison* rolled off the assembly line; first and foremost, the aircraft had no crew rest area, galley or toilet – no small thing on long missions.

The production-standard 3M was inferior in range to the prototypes – with an identical 5-ton (11,020-lb) bomb load the aircraft had an unrefuelled range of only 9,440 km (5,860 miles). In February 1957 a test crew captained by Nikolay I. Goryainov successfully flew the 3M's first long-range mission which involved a refuelling from an M-4-2 tanker captained by B. M. Stepanov; the bomber in question was c/n 63*0204. On 19th July 1957 the 3M flew for the first time with drop tanks suspended under the wing roots; the take-off weight was 202 tons (445,330 lb). The bomber covered a distance of 12,050 km (7,484 miles) without 'hitting the tanker', staying airborne for 15 hours 15 minutes.

At 0:20 AM Moscow time on 23rd August 1957 a 3M bomber took off from Zhukovskiy, starting out on a 20-hour ultra-long-range test mission. The seven-man crew comprised captain N. I. Goryainov, co-pilot A. S. Rozanov, navigator V. I. Milyutin, systems operator N. Faïzi, project test engineer I. G. Tsar'kov, radio operator L. N. Goosev and tail gunner S. I. Sokolov. The aircraft was fully fuelled and equipped with drop tanks; a 5-ton bomb was suspended in the bomb bay. As on the previous occasion, the take-off weight was 202 tons. Shortly afterwards an M-4-2 tanker with a 194-ton (427,690-lb) TOW took off and followed the bomber.

The intended route, which was between 15,000 and 16,000 km (9,320-9,940 miles) long, took the aircraft north to Vologda where the bomber was to jettison the drop tanks and turn onto an easterly heading towards Irkutsk and Nikolayevsk-on-Amur. Thence the 3M was to double north and west to the Severnaya Zemlya ('Northern Land') archipelago in the Arctic Ocean, proceed to Nar'yan-Mar on the Barents Sea coast, then pass over Moscow before making a big loop which would take it over Minsk and Kiev and then back home to Moscow. On the eastbound leg the bomber was to rendezvous with the tanker at a point between Kranoyarsk and Nizhneudinsk in Western Siberia, receiving 40 tons (88,180 lb) of fuel, and drop the bomb at the designated target range.

At first, everything seemed to go nicely. At 8,700 m (28,540 ft) the bomber settled into cruise mode, travelling at 800 km/g (496 mph) and climbing gently as fuel was burned off. Soon, however, things started happening. This is how Goryainov described it in his post-mission report:

'As we approached the drop tank jettison point we found ourselves over an area of heavy storm activity 300 m [990 ft] *below us. Severe static electrisation of the entire aircraft began, with long luminous stripes snaking all over the aircraft skin; a large and bright greenish-blue electric 'lantern' appeared at the tip of the refuelling probe, which we tried to put out by scavenging the probe with nitrogen. The entire aircraft was aglow with powerful electric discharges, and at first it appeared to the crew that fires had broken out in several places at once.*

'At the same time the aircraft was hurled sharply downwards, with bank angles approaching 50-55°, despite all efforts my co-pilot and I made to hold the aircraft steady.

'Seconds later the aircraft was in the heart of the thundercloud. Powerful updrafts and downdrafts hurled the aircraft every which way, which was accompanied by sharp rolls

Two probeless 3MS-2 tankers pass over Kubinka AB near Moscow in echelon starboard formation during the 'open doors' day on 11th April 1992 on the occasion of Spaceflight Day. The lead aircraft is '21 Red' (ex '24 Red', c/n 7350601).

and strong electric discharges. At this point the No. 3 (starboard inner) engine flamed out, followed a few seconds later by the Nos. 1 and 4 (port and starboard outer) engines. In these extraordinary circumstances the entire crew never stopped fighting the elements, trying to bring the machine back to normal flight. Co-pilot Engineer-Colonel Rozanov kept relighting the engines, but these flamed out again after the next gust and sharp roll. The tail gunner reported seeing long sheets of flame coming out of the nozzles with each relight – so long that they reached the tail of the aircraft. The probable reason for this is that substantial amounts of fuel accumulated in the combustion chambers due to disruptions in the electric igniters' operation.

'The powerful electric discharges also affected the electric system: the lighting went out intermittently and the operation of the radio and the intercom was disrupted. At the same time the aircraft began to ice up – first and foremost the pitot heads, which caused an airspeed indicator failure; therefore we activated the pitot and engine de-icing systems.

'All the time while the aircraft was passing through the thunderclouds we had to rely solely on our instruments, as there was no sight of the ground or celestial objects; all we could see through the glazing was the electric discharges which dazzled us. The Rubidiy radar sight helped us avoid the areas where the electric discharges were at their strongest, even though the Rubidiy itself was disabled three times by electric discharges which burned out the fuses.

'At a point when three engines were inoperative and the aircraft was losing altitude sharply, the drop tanks and the bomb were jettisoned to shed excess weight. As we had lost radio contact with the ground, we radioed the M-4 [tanker], reporting that we had hit a storm and suffered multiple engine flameouts. Powerful downdrafts had dropped us from 9,300 m [30,510 ft] to 4,800 m [15,750 ft]; only then did we break clear of the storm. The aircraft was inside the thundercloud for 10 or 12 minutes.

'Analysis of the barograph (flight data recorder – *Auth.*) *chart revealed that the aircraft had lost 4,800 m* (sic! 4,800 x 2 = 9,600 – *Auth.*) *in 40 seconds, ie, the sink rate had been more than 100 m/sec* [19,680 ft/min]. *After leaving the storm front all the engines were restarted and ran normally.*

'Considering the severe stresses the airframe had been subjected to during this mission and considering that the mission schedule had been wrecked, I chose to return to base. To effect a normal landing it was necessary to reduce the all-up weight by burning off fuel; therefore the aircraft remained airborne for about eight hours after leaving the storm front.

'We landed at Lookhovitsy airfield because LII's airfield was closed down by fog.

'Despite being thrown about by strong gusts, with large bank angles, the aircraft responded well to the controls and turned out to be tough enough, which allowed it to survive this disastrous situation.'

On 20th-21st May 1958 the fourth production 3M (c/n 63*0204) flew non-stop from Zhukovskiy to Nikolayevsk-on-Amur via Krasnoyarsk and Irkutsk and back again, supported by M-4-2 '03 Red' (or possibly '66 Red'), c/n 6302528. The 14,660-km (9,105-mile) route was flown in 18 hours 8 minutes.

The introduction of IFR capability required the bombers to be equipped with RSBN-2S Svod (Dome) and RSBN-7S Vstrecha (Rendezvous) short-range radio navigation systems (RSBN = ***rah**diotekh**nich**eskaya **sis**tema **blizh**ney navi**gah**tsii* – SHORAN). For the same reason the existing RSIU-4V command link radio gave way to an RSIU-5 set.

Later, when the production 3M was discovered by the West, the new 'solid-nosed' version received the reporting name *Bison-B*, the original 'glass-nosed' M-4 according becoming the *Bison-A*.

3MS-1 (3MS-I, 3M-S)
Bison-B production long-range bomber

Even though some of the 3M bomber's pro types enjoyed the luxury of a comp

shipset of VD-7 turbojets, not enough of these engines could be manufactured for mass production of the bomber because it took a while to overcome the VD-7's teething troubles. On the other hand, plant No. 23 had to keep turning out *Bison-Bs*, which it could not do if no engines were forthcoming.

The situation was resolved when the Myasishchev OKB, the plant and the Air Force compromised, agreeing that, as a temporary measure until the VD-7 had been fully mastered in production, the early-production 3Ms would be powered by RD-3M-500As, RD-3Ms or even AM-3As (of which a considerable stockpile existed). Such aircraft were designated 3MS-1 (sometimes rendered as 3MS-I), the S standing for ***staryye dvigateli*** – old engines!

3MS-2 (3MS-II)
Bison-B flight refuelling tanker

The 3MS-1 bomber could be easily reconfigured for the tanker role by installing a KAZ HDU and the associated auxiliary tanks in the bomb bay. By analogy with the M-4-2 the resulting tanker was designated 3MS-2 (or 3MS-II) and could be reconverted just as easily by removing the HDU. In the 1970s and 1980s nearly all 3MS bombers in service with the VVS were converted to 3MS-2 tankers in accordance with a specially developed schedule.

Head-on view of a 3MN-1 bomber. Note the probe illumination light buried in the nosecone.

3MN-1 (3MN-I, 3M-N)
Bison-B production long-range bomber

A version of the VD-7 derated to 9,500 kgp (20,940 lb st) to improve reliability was developed as the VD-7B. While having the same take-off thrust as the RD-3M-500A turbojet, the new engine boasted a much lower SFC – 0.7-0.8 kg/kgp·hr versus 1.0 kg/kgp·hr. This was because the VD-7B had an overall engine pressure ratio (EPR) of 11.2 versus 6.4 for the RD-3M-500A and a mass flow of 176 kg/sec (388 lb/sec) versus 162 kg/sec (357 lb/sec).

Taking due note of the compressor blade failures encountered on VD-7 turbojets, on 18th December 1958 the Council of Ministers issued a directive supporting the proposal floated by the Air Force and MAP to temporarily derate the VD-7 from 11,000 kgp (24,250 lb st) to 9,500 kgp and authorising plant No. 23 to manufacture a dozen 3M bombers powered by the derated Dobrynin engines. The version powered by VD-7Bs was designated 3MN-1 (also rendered as 3MN-I or 3M-N), the N standing for ***novyye dvigateli*** – new engines. The same directive authorised installation of VD-7Bs on seven in-service aircraft.

When the engine had worked up an adequate reliability level, plant No. 23 started equipping production aircraft with VD-7B turbojets. In January 1961 the engine's time between overhauls was set at 200 hours.

The 3MN-1 had a maximum TOW of 203 tons (447,530 lb); this configuration involved carrying two 6,500-litre (1,430 Imp. gal.) drop tanks under the wing roots on Der5-48 shackles. Even in 'clean' configuration (without drop tanks) the 3MN's range was 15% greater than that of the 3MS thanks to the more fuel-efficient engines. Since the VD-7 installation required structural changes to the *Bison*'s wings, the 'old' and 'new' engines were non-interchangeable; hence the 3MS served on alongside the 3MN.

According to some sources, the VVS took delivery of 47 Dobrynin-engined *Bison-Bs*. The 3MN fleet was subsequently based at Engels-2, Siauliai and Seryshevo ABs.

3MN-2 (3MN-II)
Bison-B flight refuelling tanker

In the same way as the 3MS-1, the 3MN-1 could be converted into a refuelling tanker by installing a KAZ HDU and auxiliary tanks in the bomb bay. The Dobrynin-engined tanker version was designated 3MN-2 (or 3MN-II); like the 3MS-2, it was immediately reconvertible to bomber configuration.

3MSR-1 and 3MNR-1
Bison-B upgraded long-range bombers

Several *Bison-B* bombers with both 'old' and 'new' engines were manufactured with an

Above and below: 3MN-2 tankers taxying at their home base, Engeis-2 AB. The tanker version couid be identified by the iack of a refueiiing probe.

Above and below: Two 3MS-2 tankers (the lower photo shows '23 Red', c/n 6300304). Apart from the lack of IFR capability, the tankers could be identified by the additional strake aerial on the aft fuselage.

Above: 3MS-2 '27 Red' (c/n 7300604) taxying at Engels-2 AB.

upgraded avionics fit. In order to discern them from standard 3MS-1s and 3MN-1s these aircraft were unofficially designated 3MSR-1 and 3MNR-1 respectively, the R standing for ***rah****dioappara****toora*** (avionics).

Additionally, *Bison-Bs* c/ns 8301101, 8301203, 8301301 and 8301302 (or 9301301 and 9301302?) were equipped with refuelling probes of improved design. The new probe became a standard fit on all 3MS-1s from c/n 9301501 onwards.

3M-5 *Bison-B* strategic missile strike aircraft prototype

In the late 1960s NPO Raduga (pronounced rahdooga – 'Rainbow' Scientific & Production Association; NPO = *na****ooch****no-proiz****vod****stvennoye ob****yedinen****iye*), a weaponry design bureau based in Doobna north of Moscow, completed trials of the D-5 air-to-surface missile. Allocated the service designation KSR-5 (NATO code name AS-6 *Kingfish*), the missile was fielded by the Soviet naval air arm in December 1969 as part of the K-26 weapons system (K = ***kom****pleks [vo'orooz****heniya****]*) which also included the Tu-16K-26 *Badger-G* carrier aircraft. The KSR-5 came with both nuclear and conventional warheads; the initial version (AS-6A) equipped with an active radar seeker head capable of acquiring the target while still 'on the wing' was supplemented in 1972 by a passive radar homing version – the KSR-5P (AS-6B) anti-radiation missile designed to destroy enemy AD radars. The missile had fairly good performance, adequate reliability and high accuracy. Hence OKB-23 decided to expand the *Bison*'s mission range by integrating the KSR-5 missile.

A production 3MN-1 bomber (tactical code unknown, c/n 7300503) was converted into the prototype of the missile strike version designated 3M-5, the '5' referring to the type of missile carried. The conversion involved installation of a new Rubin-1ME (ruby, pronounced roobin) navigation/target illumination radar in the nose; the missiles were carried on BD-487 racks (*bahlochnyy derzhahtel'* – beam-type rack) attached to the wing structure by Der5-48 shackles. The tail gunner's station was replaced by an ogival fairing housing an SPS-151 Azaliya (azalea) active jammer, with more jammers in other parts of the airframe to give full 360° coverage; this fairing, known as the UKhO (*oonifi****see****rovannyy khvosto****voy*** *ot****sek*** – standardised tail compartment), was used with other models of ECM equipment on some versions of the Tu-16, Tu-22 and Tu-95.

Tests showed promising results, and the OKB proposed upgrading other VD-7B-pow

This *Bison-B* caught by the camera as it 'cleans up' after take-off (note the angle of the outrigger struts) is almost certainly a 3MS-2 with RD-3M engines, judged by the absence of an awful smoke trail even at full power.

ered *Bisons* to 3M-5 standard in order to increase their punch. However, by the early 1970s the 3Ms, which did quite a lot of flying, were reaching the limit of their designated service life; it was necessary to hold a new series of static tests and see if a service life extension warranting such an upgrade was possible, and the issue basically boiled down to money. The VVS was unenthusiastic about the upgrade, claiming it would be easier to retire the *Bisons* and replace them with new bomber types. Apparently Vladimir M. Myasishchev himself did not press the issue, believing the new bombers OKB-23 had in the making would be accepted. Besides, 3M production had ended by then, and plant No. 23, which had built the type, was up to its eyes in missile and space launch vehicle (SLV) production programmes. Thus the 3M-5 programme was abandoned, as nobody seemed to mind.

Incidentally, the Air Force had tasked the Tupolev OKB with adapting the Tu-95 for carrying the KSR-5 missile. Accordingly a production Tu-95M *Bear-A* (c/n 8800601) was converted to the Tu-95M-5 prototype in October 1976 by fitting two missile pylons, a modified Rubin-1KV radar and an SPS-153 jammer in a UKhO tail fairing. The aircraft entered flight test in the autumn of 1976 but the programme was terminated in May 1977. Eventually the VVS settled for the Kh-22 (AS-4 *Kitchen*) ASM having both a larger warhead and longer range. The Soviet government decided that only Tu-95 bombers were to be converted into missile carriers by the plant which built them, which led to the appearance of the Tu-95K-22 *Bear-G*.

Testbed versions of the 3M

Several production *Bison-Bs* were modified under various test and development programmes. In 1968 Myasishchev decided to build two aerodynamics research aircraft based on the 3M; one was to feature a modified wing leading edge for boundary layer control (BLC) as a method of reducing drag while the other aircraft was to have laminar-flow outer wings. After the results of calculations had been checked in a series of wind tunnel tests, the OKB manufactured experimental skin panels featuring narrow slits and minute perforations for boundary layer evacuation. This and other methods of airflow lamminarisation were tested on a modified 3M (identity unknown) and in laboratories; they included everything from the use of specially developed laminar-flow airfoils and polishing the wing surface to cooling the wing skin.

When the Il'yushin IL-62 four-turbojet long-haul airliner (NATO reporting name *Classic*) entered production, the need arose to extend its range to permit transoceanic flights. In 1977 Vladimir M. Myasishchev suggested using the 3M as a research vehicle under the IL-62 range increase programme. The work proceeded in close co-operation with TsAGI, LII, the Siberian Aviation Research Institute (SibNIA – *Sibeerskiy naoochno-issledovatel'skiy institoot aviahtsii*) and the Siberian branch of the Soviet Union's Academy of Sciences – to be precise, the Theoretical and Applied Mechanics Institute. The latter was then headed by Academician Vladimir V. Stroominskiy, a former TsAGI researcher who had worked with Myasishchev in the 1950s, aiding in the creation of OKB-23's swept-wing strategic bombers.

3ME (3M-E) long-range bomber prototype

By 1958 some of the avionics fitted to the production-standard 3M had become obsolete, no longer meeting the growing requirements of the Air Force. On the other hand, new advanced radars, LORAN systems, radios, etc. had become available, albeit in prototype form only. Considering this, on 7th August 1958 the Council of Ministers issued directive No. 908-425 ordering OKB-23 to equip the 3M bomber fleet with up-to-date avionics. The new equipment was to comprise a Rubin-1 bomb-aiming radar, a PRS-3Ts Argon-2 gun ranging radar, a Gheliy (Helium) transmitter and an SPI-3M LORAN system.

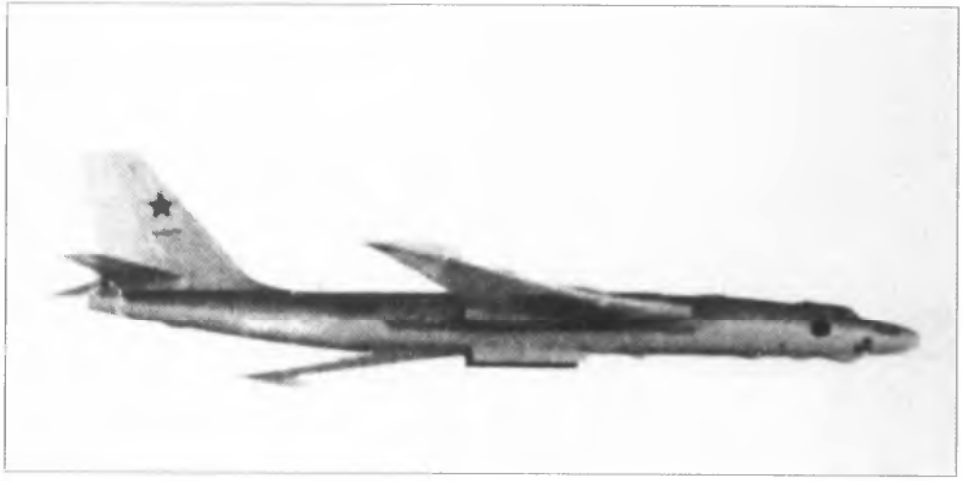
Pursuant to this document the OKB was to issue a set of drawings and specifications for outfitting two *Bison-Bs* with the stated avionics before the end of August (ie, within three weeks), and the aircraft were to be transferred to GK NII VVS for checkout trials in October and November 1958. Proceeding from the results of these trials, a decision whether to manufacture new *Bisons* to this standard or not would be taken in 1959. The same directive also tasked OKB-23 with looking into the possibility of arming the 3M with guided missiles while still retaining the capability to carry conventional and nuclear free-fall bombs, and the possibility of upgrading the existing 3M fleet in this fashion.

The new bomber was designated 3ME; the suffix letter did not appear to have any particular meaning in this case. The upgraded prototype was to become the etalon (production standard-setter) for 1959.

The 3ME was to feature a Rubin-1 radar with an FARM-2 photo-recording module (equivalent to a gun camera) instead of the standard RBP-4 radar, an OPB-112 optical bomb sight instead of the standard OPB-11R, an NBA automatic navigation/bomb release module (*navigatsionnyy bombardirovochnyy avtomaht*) instead of the standard NI-50BM navigation display (*navigatsionnyy indikahtor*), an RV-25 high-range radio altimeter instead of the standard RV-17, a PRS-3Ts Argon-2 gun ranging radar instead of the standard PRS-1 Argon-1, an SPI-3M LORAN system instead of the standard SPI-1 and a Gheliy transmitter instead of a 1-RSB-70. New equipment also included a GIK-1 gyro-flux gate compass (*gheeroindooktsionnyy kompas*) and FRS-200 landing/taxi lights.

The changes in the avionics fit brought about a redesign of the bomber's forward and rear fuselage extremities. The 3ME had a characteristically pointed nose with the IFR probe installed at the tip rather than on top and flanked by two small windows for the probe illumination lights; the radome was reprofiled, featuring characteristic 'cheekbone' bulges at the sides. This 'nose job' was meant to reduce drag and improve visibility for the bomb-aimer while providing enough room for the bulky antenna of the Rubin-1.

The radome of the gun ranging radar was considerably enlarged to accommodate the larger antenna of the Argon-2; this even required the rudder to be cut away at the base, reducing its area by 0.3 m² (3.2 sq. ft). More effective though the new radar was, it brought about an inconvenience for the tail gunner who could now eject only after sliding his seat all the way back. New wing airfoils with a revised front end (due to new wing leading-edge sections) were also envisaged.



Bombs away? No indeed! This is a 3MS-2 tanker (in the old convertible configuration, as indicated by the large bomb bay doors) just about to depioy the drogue.

The Rubin-1 radar was largely automatic, obviating the need for a radar operator; therefore the position near the port beam blister where he used to sit was now the radio operator's workstation. However, a second navigator was introduced because the missions could last up to 20 hours and the workload would be too much for one navigator; the co-navigator sat beneath the dorsal blister.

Since OKB-23 was already working on a new version of the *Bison* designated 3MD (see below), all redesign work and crew responsibility redistribution proceeded on the premise that the features developed for the 3ME would be incorporated in the 3MD without any changes. Indeed, the intention was that 3ME bombers would later be converted to 3MD missile strike aircraft.

The experimental shop of OKB-23 built full-scale systems integration mock-ups of the 3ME's new nose and tail sections. Upon inspecting them the mock-up review commission made a few critical comments, mostly concerning the choice of equipment. Among other things, it was suggested that the bomber should be fitted with signals intelligence (SIGINT) and ECM equipment, plus a radar homing and warning system (RHAWS).

Two 3MN-1s (c/ns 8301101 and 8301203) were earmarked for conversion as the 3ME prototypes. Eventually, however, only the first aircraft was converted because deliveries of the intended new systems were running seriously late.

The aforementioned CofM directive of 7th August 1958 obliged the Rybinsk engine factory No. 36 (seat of Dobrynin's OKB-36) to increase the VD-7's TBO to 200 hours in the first quarter of 1959 and commence mass production in the second quarter of the year. Moreover, the modified engines were to have a further reduced SFC of 0.69-0.7 kg/kgp·hr, which would give the aircraft 300 km (186 miles) greater range.

To enhance the 3ME's fire protection the aircraft was provided with new flame sensors, an inert gas pressurisation system and a modified fire extinguishing system serving the fuel cell bays in the fuselage. An extra RSIU-5 command link radio and a *Pritok* (Tributary) system were installed, ensuring secure rendezvous with M-4-2 tankers; SOD-57M distance measuring equipment (*samolyotnyy opredelitel' dal'nosti*) was provided to increase interaction range with friendly ground control radars. No changes were made to the armament; contrary to the original plans the wing leading edges likewise had to be left unaltered because the programme was seriously behind schedule.

Conversion of 3MN-1 c/n 8301101 to the 3ME prototype was completed in March 1959. Flown by a factory test crew, the uncoded aircraft made seven pre-delivery test flights totalling 12 hours 21 minutes before it was handed over to OKB-23. Myasishchev OKB test pilots started flying the 3ME on 18th June 1959; exactly two months later they were superseded by GK NII VVS crews. As regards performance and handling, the 3ME was no different from a standard 3MN-1; however, the much greater target detection range of the Rubin-1 radar as compared to the old RBP-4 made the 3ME a rather more potent combat aircraft (this radar was later fitted to the production 3MD).

The career of the 3ME prototype came to an abrupt end on 12th May 1960. While doing engine runs at the OKB's flight test facility in Zhukovskiy, the prototype of the M-50 supersonic bomber jumped chocks and crashed into the 3ME parked across the apron from it. The *Bison* suffered serious damage to the nose and starboard wingtip; one man on the 3ME was killed and two more suffered minor injuries. After this accident the 3ME was struck off charge and scrapped; the M-50 was more fortunate, returning to flight status after repairs had been made.

In October 1960 OKB-23 was transferred from the GKAT framework to the Ministry of General Machinery (MOM – *Ministerstvo obshchevo mashinostroyeniya*), the agency responsible for the Soviet missile weapon and space programmes, becoming a branch office of OKB-52 headed by Vladimir N. Chelomey, one of the Soviet Union's top authorities in missile and space systems design. (Incidentally, Sergey N. Khrushchov, the Soviet leader's son, worked at OKB-52 – though this was hardly a factor which influenced the decision.) The project material and know-how amassed by the former Myasishchev OKB were transferred to the Tupolev OKB and Pavel O. Sukhoi's OKB-51, while Vladimir M. Myasishchev himself was appointed Director of TsAGI – ie, 'kicked upstairs'.

The sole prototype 3ME (c/n 8301101) with flaps set for take-off. Though the redesigned sharper nose is not obvious here, this three-quarters rear view shows the enlarged radome of the gun ranging radar and the consequently cut-away rudder, as well as the VD-7B engines.

Above: The production 3MD *Bison-C* inherited many of the features tested on the one-off 3ME, including the characteristically restyled nose with the iFR probe at the tip which earned it the nickname *stilyaga* (top).

3M-A nuclear-powered reconnaissance aircraft project

In 1957 the Myasishchev OKB worked on a derivative of the 3M with a nuclear powerplant comprising a reactor installed in the bomb bay and four nuclear turbojets using a gaseous heat transfer medium. Called 3M-A (*atomnyy* – nuclear), the aircraft was intended for long-endurance reconnaissance. The crew sat in a heavily shielded compartment without side widows or blisters which made the aircraft look like a mutant blind fish. A technology demonstrator was to fly in 1959, followed by a prototype in 1960.

3M-M flying-boat project

An even more exotic project developed concurrently was a flying-boat derivative of the 3M with a boat hull and stabilising floats under the wingtips. Designated 3M-M (*morskoy* – nuclear), it was to have a range of up to 25,000 km (15,530 miles).

3M-R flying-boat project

A projected version of the 3M designated 3MR was to carry high-speed reconnaissance drones.

3MK (3M-K, 3M-K-20) strategic missile strike aircraft project

In the post-war years the efficiency of the Western nations' air defence systems increased dramatically. Penetrating these air defences would be close to a Mission Impossible for bombers carrying ordinary free-fall bombs (especially if they were subsonic aircraft). The answer was to turn the classic bomber into a launch platform for stand-off weapons – ie, guided missiles which would be launched from outside the heavily defended areas. By virtue of its high speed and flight altitude the missile could penetrate the air defences with impunity, then dive down onto the target and obliterate it. Importantly, the radius of action of a missile-toting aircraft was bigger than that of an ordinary bomber. This logically led to the decision to develop such weapons systems for the Soviet Air Force's long-range bomber arm (DA – ***Dahl'****nyaya* a*v**iaht**siya*).

Development of a missile strike version of the production *Bison-A* or *Bison-B* was triggered by Council of Ministers directive No. 412-182 dated 11th March 1954. Pursuant to this document the Myasishchev OKB was to develop the 'aircraft MK' missile platform – one of the main components of the 3M-K-20 weapons system. The same directive tasked Artyom I. Mikoyan's OKB-155 with creating the Kh-20 long-range cruise missile (NATO code name AS-3 *Kangaroo*), while the KB-1 design bureau led by V. M. Shabanov was to develop the missile's guidance system. (Actually the missile was designed by OKB-2-155,

The nose section of 3MD '30 Red' (c/n 0301804), the sole surviving example, preserved at the Central Russian Air Force Museum in Monino (hence the company of Antonov An-22 CCCP-09334 visible beyond).

3MD '49 Red' (probably the very aircraft that was displayed at Moscow-Domodedovo on 9th July 1967) takes off.

a branch of the Mikoyan OKB headed by A. Ya. Bereznyak.) The Tupolev OKB was similarly ordered to evolve a missile strike variant of the Tu-95. TsAGI was also to participate in the programme as a systems integrator.

Preliminary design work at OKB-23 began straightaway after the CofM directive. On 24th December 1954 the Council of Ministers issued instruction No. 13577 specifying that the missile and associated guidance system were to be identical for 'aircraft MK' and the missile-toting Tu-95 version, followed a week later by MAP order No. 763 to the same effect. Plant No. 23 was required to modify a single 3M bomber, delivering it to the Air Force in the second quarter of 1956.

Pursuant to instruction No. 13577 'aircraft MK' was to have a combat radius of 7,500-8,000 km (4,660-4,970 miles) with one fuel top-up en route to the target. The single missile was to be launched at 11,500-12,000 m (37,730-39,370 ft), the aircraft climbing to 12,000-12,500 m (39,370-41,010 ft) shortly afterwards; cruising speed with the missile attached was specified as 770-800 km/h (478-496 mph). MOM, which was responsible for the guidance system, did not specify any requirements which the aircraft had to meet.

One of the major issues the engineers had to resolve at the ADP stage was how the Kh-20 would be carried by the aircraft. Finding the best location wasn't at all easy because of the *Bison*'s bicycle undercarriage and the resulting nose-up ground angle. Four options were considered. Version 1 involved carrying the Kh-20 on a pylon under the starboard inner wing, with a large drop tank symmetrically to port. This configuration required minimum changes to the airframe; aside from the installation of the missile guidance system, all that was necessary was some local reinforcement of the wings and the provision of two hardpoints, one of which was 'wet'.

Version 2 was rather unconventional: the missile was carried on a pylon above the wing centre section, standing proud of the fuselage! Again the structural changes were minor in this case; however, this configuration required research into the dynamics of the aircraft and missile at the moment of separation, the effect of the missile's jet exhaust on the bomber's airframe and ways of jettisoning the missile in an emergency.

In Version 3 the missile was semi-recessed in the bomber's belly and lowered clear of the fuselage on a trapeze before engine start-up and disengagement. This looked straightforward – until you remember the bicycle landing gear and small ground clearance, which opened a very large can of worms. Firstly, the missile could not just be wheeled in on a dolly and hoisted up into the belly, as there was not enough room for the tall fin; a trench needed to be dug at the loading station, and how do you place a bicycle-gear aircraft over a trench? Secondly, this arrangement precluded the use of the aircraft for delivering free-fall bombs – which, the reader will recall, was a requirement.

The fourth version was the most bizarre of all. The missile was carried inverted under the forward fuselage so that its rear fuselage was semi-recessed in the bomber's extreme nose directly under the flightdeck, creating the eerie impression that the bomber was chewing the luckless missile! Even though the structural changes were relatively minor, the missile obstructed the radar's field of view, complicating navigation and storm avoidance, and precluded crew ejection unless it was jettisoned first.

That said, the choice was quickly narrowed to versions 1 and 2 which were tested in TsAGI's T-106 wind tunnel. Calculations and wind tunnel tests revealed that in both versions the aircraft had identical range and an identical lift/drag ratio. However, the underwing option was clearly preferable, as it did not require research into how the missile's exhaust affected the bomber's tail and the jettison procedure was straightforward.

Upon completion of the ADP documentation OKB-23 built a full-scale mock-up of 'aircraft MK' with the Kh-20 missile and drop tank installed. Also known as the 3MK (K = *kompleks [vo'oroo**zheniya**]*), the missile strike version differed outwardly from the standard *Bison-B* in having a reprofiled nose: as was the case with the competing Tu-95K-20 *Bear-B*, the main antenna of the YaD target illumination radar was wider than the fuselage, resulting in a distinctive 'duck bill' radome. The preliminary inspection by the mock-up review commission took place on 15th August 1955; after changes based on the commission's findings had been incorporated, the mock-up was presented for final review which took place on 12th-20th January 1956. The commission examined the arrangement of the YaD radar modules, the pylons for carrying the Kh-20 missile, the Mikoyan-Gurevich SM-20 'point-site fighter' (a missile guidance system test-bed version of the MiG-19 *Farmer-A*) and the drop tank the commission gave a thumbs-

Manufacturer's flight tests of the 3MK prototype were slated to begin in 1957, proceeding in two stages; Stage A would involve the SM-20 testbeds, while inert and live Kh-20 missiles would take their place during Stage B. Alas... on 1st January 1956 the Tu-95K-20 prototype made its first flight. This was the crack of doom: from that day on the VVS and MAP started favouring the Tupolev OKB and its projects. Besides, as already mentioned, the 3M prototype entered flight test on 27th March 1956, and this programme taxed the Myasishchev OKB's resources heavily. Hence the 3MK project began winding down. Also, some of the OKB's engineers believed the Kh-20 was outdated and could not meet current requirements, and the idea of arming the 3M with the more capable *izdeliye* 44 cruise missile was already under consideration. Finally, the semi-recessed carriage of the Kh-20 on the Tu-95K was admittedly a better solution from an aerodynamic standpoint. The *Bear*'s tricycle undercarriage and large ground clearance (a side-effect of the turboprop powerplant) posed no problems for this.

3MD (3M-D) *Bison-C* long-range bomber/ missile strike aircraft ('1960-standard 3M')

While the Tu-16K-10 *Badger-C*, Tu-95K-20 and some other missile strike aircraft had entered service with the DA and the Naval air arm (AVMF – *Aviahtsiya voyenno-morskovo flota*) by the late 1950s, they were seriously flawed in certain respects. This prompted OKB-23 to create a more advanced weapons system based on stand-off missiles. The Myasishchev OKB already had some experience in the field; apart from the abortive 3MK project described earlier, in 1954-56 it had tried adapting K-10S (AS-2 *Kipper*) subsonic cruise missiles and a long-range supersonic cruise missile to the 3M (again, neither of these projects reached the hardware stage).

In May 1958 the OKB completed the advanced development project of an aircraft designated M-6K. In missile-armed configuration it was intended for destroying surface ships, primarily aircraft carrier groups, yet it fully retained the capability to carry free-fall bombs. With the not-too-distant future in mind the Myasishchev OKB, working together with OKB-52, contemplated development of a weapons system comprising an aircraft designated 3MD and the P-6 (alias P-35) anti-shipping cruise missile. The missile featured radio command guidance, a range of 800 km (496 miles) and a top speed of 2,000 km/h (1,240 mph). If the P-6 missile were selected the aircraft would have to be equipped with a missile guidance system developed by OKB-283; an alternative guidance system offered by the NII-10 research institute needed modifications in order to be integrated with the aircraft's systems and equipment.

Upon careful consideration, the Myasishchev OKB deemed it more advisable to use the KSR and K-10S missiles designed by OKB-2-155 with minor changes to their systems. The intention was to modify the bomber's Rubin-1 radar as well, turning it into the core of the K-4-2 guidance system working with KSR missiles or the K-14 guidance system working with K-10S missiles. The system's range would be 160 km (99 miles) or 250-300 km (155-186 miles) respectively, increasing to 800-1,000 km (496-620 miles) if the Yantar' (Amber) radio command guidance unit was used. To work with the K-4-2 and K-14 guidance systems the KSR and K-10S missiles needed to have their standard guidance modules replaced with homing seeker heads developed by OKB-283.

Concurrently changes would be made to the aircraft itself. The nose was reshaped to improve the navigator/bomb-aimer's field of view; the radio operator's workstation was moved to the port beam blister. An inert gas pressurisation system was introduced, along with a more effective fire extinguishing system serving the fuel cell bays in the fuselage. The avionics fit was upgraded with new items, including the Gheliy transmitter, RV-25 radio altimeter and ARK-54B ADF. Provisions were

This positively civilian crowd around a 3MD is explained by the fact that the picture was taken during the 1967 Moscow-Domodedovo air show.

made for SU-50 JATO bottles (*startovyy ooskoritel'*) mounted under the wing roots. Finally, rudder area was reduced.

As already mentioned, the CofM directive of 7th August 1958 concerning the 3ME bomber tasked OKB-23 with looking into the possibility of integrating guided missiles on the 3M while still retaining normal bomber capability and upgrading the existing 3M fleet to this standard. Hence the Myasishchev OKB evolved the 3M-K-14 strategic weapons system comprising the 3MD bomber armed with two K-10S missiles. With one fuel top-up the 3MD would be able to attack targets up to 6,850-7,000 km (4,250-4,350 miles) away from base; the missiles would be fired 250 km (155 miles) from the target. The aircraft had full conventional/nuclear bomber capability; this versatility was an advantage over the Tu-16K-10 and Tu-95K-20, both of which were dedicated missile carriers.

The 3M-K-14 weapons system allowed various missile types to be used, provided they were made compatible with the Rubicon guidance system. The conversion of a 3M bomber to 3MD standard involved mainly installation of the Rubicon system (built around a modified Rubin-1 radar) and installation of missile pylons under the wings. In overall performance the 3M-K-14 weapons system was similar to the data set forth in the M-6K advanced development project.

Until mid-1959 all work on the 3MD, which began in the previous year, proceeded at the OKB's own risk. The OKB managed quite a lot during this period, performing wind tunnel tests and scaled-strength model tests with simulated external stores in order to verify the results of calculations and obtaining TsAGI's expert opinion on these tests. The general operating principles of the guidance system were confirmed in a series of tests using the SDK-13 avionics testbed (a modified MiG-17) and a modified Tu-4; a ground rig was built to test the missile release system, etc.

On 22nd August 1959 the Communist Party Central Committee and the Council of Ministers let loose with joint directive No. 998-435 concerning the development of the M6K-14 strategic air-launched missile system including two K-14S cruise missiles (this was a derivative of the K-10S) and a modified production 3M (M-6) bomber. This was a signal for OKB-23 to dramatically increase the tempo of design and development work on the project, which until then had proceeded at a leisurely pace. The work called for close cooperation with the OKBs responsible for the missiles and avionics, as well as with the industry's top-notch R&D establishments.

In 1959 the Myasishchev OKB released manufacturing drawings for the modified 3MD bomber/missile carrier; the design changes were kept to a minimum so as to ensure a prototype could be completed before the year was out. Taking versatility still further, at the insistence of the Air Force Myasishchev had to make provision for using the aircraft as a 3MT refuelling tanker in addition to its missile strike and bomber roles.

After completing aerodynamic calculations for the aircraft in missile carrier configuration the OKB set about building a full-scale mock-up which was completed in December 1959 and readied for presentation. Meanwhile, plant No. 23 was putting the finishing touches to the first prototype 3MD (c/n 9301301), and the second aircraft (c/n 9301302) had reached a substantial degree of completeness.

In addition to the changes incorporated into the ill-fated 3ME, the 3MD prototypes introduced other new features, including reprofiled wing leading edges (enhancing roll stability at high angles of attack) and a 40% smaller rudder which considerably eased rudder pedal forces in emergency manual control mode. The nose gear bogie was equipped with a self-contained steering system, and the IFR probe featured electric deicing. The inert gas pressurisation and fire extinguishing systems were different than hitherto; the engine starting panel was revised and the ejection seats improved. The avionics included a Veter-2 (Wind-2) Doppler speed/drift sensor, an RSBN-7S SHORAN, an RSIU-5 command link radio, an ARK-54B ADF, FRS-200 landing/taxi lights, etc.

As on the 3ME, the new equipment had brought about a rearrangement of the forward crew cabin. The radio operator's workstation was relocated from the dorsal blister to the port beam blister, and the dorsal workstation was now occupied by the co-navigator. It featured a SHORAN switch panel, an AK-53P celestial compass (astrokompas), an SP-1 panoramic sextant and a panel for starting and monitoring the missiles' Mikulin RD-9FK turbojets.

Later on, the long-range communications radio was to feature a new Rool' (Steering wheel) receiver. The new ADF provided nine-channel searchless automatic reception and was more resistant to jamming than the old ARK-5. The RSBN-2S Svod/RSBN-7S Vstrecha SHORAN permitted en route navigation by means of ground ATC beacons, landing approach and rendezvous/formation keeping.

The first prototype was completed in November 1959, making its maiden flight on 25th November at the hands of B. M. Stepanov and A. S. Rozanov. A special joint flight test programme held by the OKB and the factory got under way on 1st February 1960; by 31st March the aircraft had made 11 flights totalling 47 hours 24 minutes under this programme. An Air Force test crew flew its first mission on the 3MD in April 1960. The trials were concluded in style by a maximum-range flight; departing with a 190-ton (418,870-lb) TOW, the aircraft flew non-stop along the Zhukovskiy – Nar'yan-Mar – Amderma – Tiksi – Ambarchik – Tiksi – Nar'yan-Mar – Zhukovskiy route in 14 hours 13 minutes.

The second prototype 3MD joined the testing in 1960. Meanwhile, development and integration of the K-14S missile continued; a full set of drawings was released and a prototype pylon manufactured. Towards the end of the year, however, work on this system started winding down as the Myasishchev OKB had virtually ceased to exist, being reduced to a division of the OKB-52 missile design bureau. Nevertheless, in late 1960 or early 1961 a K-14S missile was actually hooked up to 3MD c/n 9301301 at the OKB's former flight test facility in Zhukovskiy.

In 1962 the first prototype was used in another test programme with an uprated 11,300-kgp (24,910-lb st) VD-7P engine replacing the No. 2 VD-7B. Test pilot L. V. Vla-sov made 20 flights which yielded good results; still, the VD-7P never entered production. (Some sources misidentify this aircraft as the 3ME or even as the '3MP with four VD-7Ps' – a version which never existed.

In a repeat of similar occurrences in the earlier history of the Myasishchev OKB, the 3MD entered production when the flight test had barely begun. A mere nine production examples were built in 1960 (c/ns 0301701 through 0301705 and 0301801 through 0301805); hence the type was referred to in official documents by the rather incongruous phrase '3M manufactured in 1960' (or '1960-standard 3M'). In service these aircraft were usually the mounts of squadron, regiment or division commanders.

Two 3MDs were lost in accidents during the type's service period. On 12th June 1[illegible] a fire erupted on aircraft c/n 0301801. Trying to reduce the all-up weight in anticipation of a forced landing, the crew opened the fuel jettison valves, which only made the fire worse. As a result, the bomber came down in a field short of the runway, killing the crew. Later (the exact date is unknown), the first prototype, which had been delivered to a first-line unit stationed in the Far East, came in too low and went smack into a hill while returning from a long-range mission over the Sea of Japan. Navigational error was the cause this time.

The new front end treatment of the 3MD was obvious enough to warrant a new NATO reporting name, *Bison-C*. In the VVS, however, the aircraft's turned-up nose, giving it a haughty air, earned it the nickname *stilyaga* (translates loosely as 'fop').

The 3MD was unveiled to the general public on 9th July 1967 when a single example was in the static park at the grand air festival at Moscow-Domodedovo airport. Thank[illegible]

one of the *Bison-Cs* ('30 Red', c/n 0301804) has been preserved for posterity at the Soviet (now Central Russian) Air Force Museum in Monino near Moscow.

3MT (3M-T – first use of designation) flight refuelling tanker project

As noted earlier, Communist Party Central Committee/Council of Ministers joint directive No. 867-408 tasked OKB-23 with developing a refuelling tanker which would work with the M-52 supersonic missile strike aircraft (the proposed production version of the M-50 which never flew), 3M and other bombers using the probe-and-drogue system. The aircraft received the provisional designation 3MT, the T standing for ***top****livoza****prahv****shchik* – refuelling tanker.

The 3MT was based on the ultimate production version, the 3MD, and was to outperform the M-4-2 by a substantial margin. For instance, according to calculations it would have given a 3M bomber a range of 3,400 km (2,110 miles) with a single top-up, which was 800 km (496 miles) more than the M-4-2 could achieve. Maximum transferable fuel totalled 73 tons (160,935 lb) versus the *Bison-A*'s 40 tons (88,180 lb); the fuel delivery rate was increased from the M-4-2's 2,400 litres (529 Imp. gal.) per minute to 4,500-5,000 litres (990-1,100 Imp. gal.) per minute.

Since the 3MT was based on the *Bison-C*, it could also fill the missile carrier and bomber roles if necessary after the HDU and auxiliary tanks had been removed, which could be done rapidly in a hangar. The 3MT's fuel system differed from that of the 3MD mainly in that extra fuel transfer pumps were installed in certain groups of tanks and several additional pipelines were fitted; otherwise the two were identical.

Above: 3MD '49 Red' at Moscow-Domodedovo on 9th July 1967 in company with some of Aeroflot's rotary-wing types – Mil' Mi-1M, Mi-4P and Mi-6 helicopters.

Being part of the M-6K-14 strategic weapons system, the 3MT was assessed by the same mock-up review commission as the 3MD. Eventually, however, it remained a 'paper plane' due to the closure of OKB-23 in September 1960.

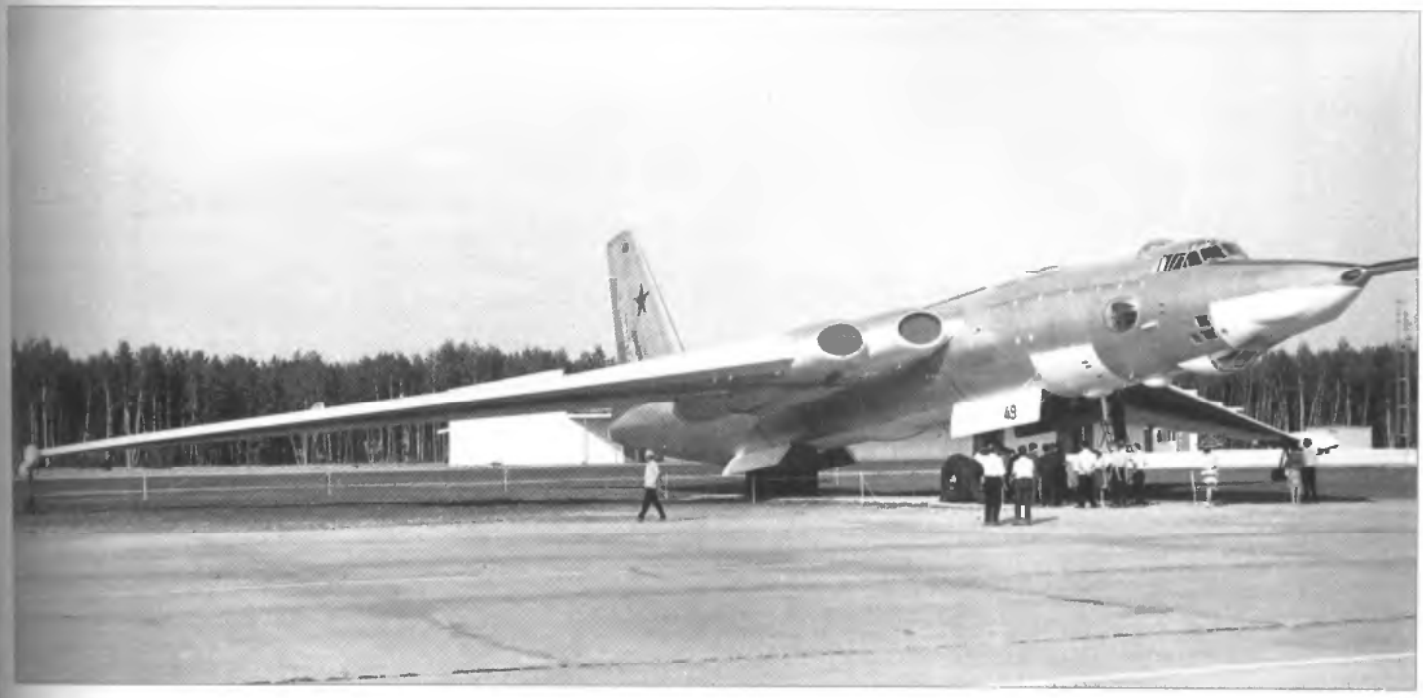
3MP (3M-P) flight refuelling tanker project

In the 1960s the Air Force considered outfitting in-service 3MDs for the tanker role by analogy with the 3MS-2 and 3MN-2. The would-be conversion received the designation 3MP. The design of the 3MP's refuelling system gave it a quick-change capability – the aircraft could be quickly equipped as a tanker or reconverted to bomber configuration in the field.

As on the 3M, the co-pilot doubled as the flight engineer. In tanker configuration the refuelling systems officer's station was fitted out instead of the ECM officer's station; the tail gunner also participated in the refuelling operation, monitoring the contact with the receiver aircraft and activating the HDU servo loop in full auto mode. In the receiver aircraft, the co-pilot controlled the machine during the refuelling procedure and monitored the fuel status.

The 3MP was to support all types of heavy aircraft featuring the probe-and-drogue IFR system, transferring up to 43.5 tons (95,900 lb) of fuel at up to 2,500 litres (550 Imp. gal.) per minute. This was to give the receiver aircraft up to 3,750 km (2,330 miles) longer range. The conversion to 3MP standard would involve nothing more than installation of fittings for the HDU and fuel connectors, plus some additional avionics to ensure the rendezvous with the receiver aircraft.

Since the few *Bison-Cs* built were used chiefly as commanders' 'hacks' after the liquidation of the Myasishchev OKB and the end of 3MD production, converting them was not worthwhile and the project was dropped.



Another view of '49 Red' at Domodedovo before the really big crowds came in. The 3MD lacked most of the 'anti-radiation' white colouring of the fuselage underside characteristic of the M-4 and 3MS/3MN.

An atmospheric night shot of a 3MD.

Chapter 4

The M-4 in Detail

The following structural description applies to the standard Myasishchev M-4. Details of other versions are indicated as appropriate.

Type: Four-engined long-range bomber. The crew consisted of eight persons accommodated in two pressurised cabins (the captain, co-pilot, navigator/bomb-aimer, flight engineer/gunner, gunner/radio operator, navigator/radar operator and dorsal gunner in the forward cabin and a tail gunner in the rear cabin).

The airframe was of all-metal construction, being made largely of V95A-T aluminium alloy, D16T and D16A-TV duralumin; some structural components were made of AK6 aluminium alloy, 30KhGSA grade steel, MA8 and ML5-T4 magnesium alloys.

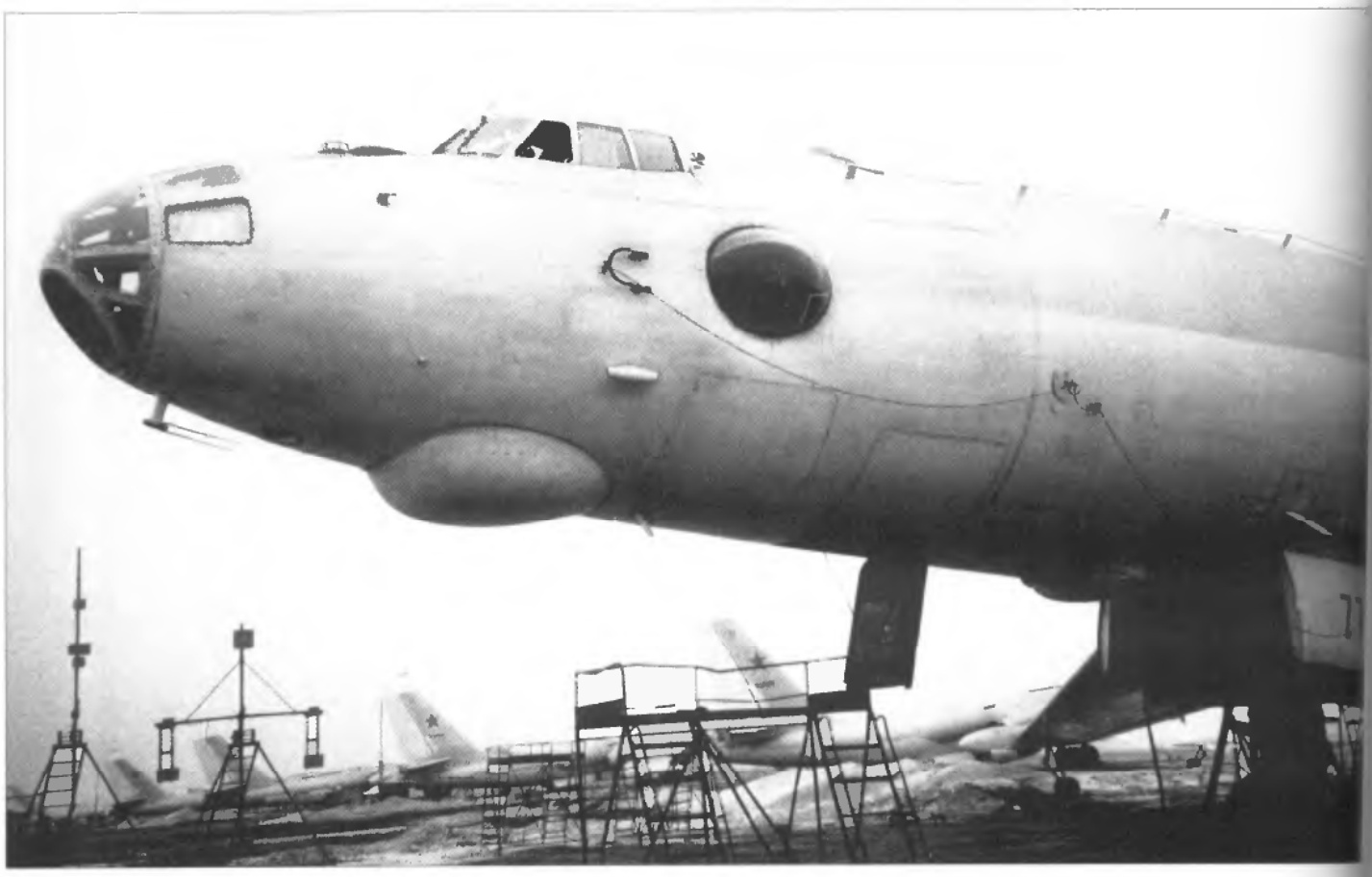
Fuselage: Semi-monocoque stressed-skin structure of beam-and-stringer construction with stamped stringers and frames; skin thickness was 1-4 mm (1/32 to 5/32 in) and flush riveting was used throughout. Length 45.6 m (149 ft 7¼ in), maximum diameter 3.5 m (11 ft 5¾ in). The fuselage was of basically circular cross-section; the centre portion was a perfect cylinder whose axis coincided with the fuselage waterline (FWL).

Structurally the fuselage was made up of four sections: the forward fuselage (frames 1-16), the centre fuselage (frames 17-76), the aft fuselage (frames 77-110) and the rear fuselage or tail section (frames 111-115). The sections were joined at the end frames by fittings made of a special alloy and hardened-steel bolts.

The pressurised ***forward fuselage (Section F-2)*** was the main crew section (the navigator/bomb-aimer sat in the extreme nose slightly below the pilots, while the flight engineer/gunner, gunner/radio operator, navigator/radar operator and dorsal gunner sat just aft of the flightdeck). It also accommodated the greater part of the navigation, communications and targeting/weapons control system components. The pressure cabin had a volume of 18.5 m³ (653.32 cu. ft). Section F-2 terminated in a pressure dome. To ensure adequate pressurisation all rivet joints were sealed with a special elastic tape placed between the skin and the internal structure (frames and stringers) before riveting and a sealing compound brushed on over the joint.

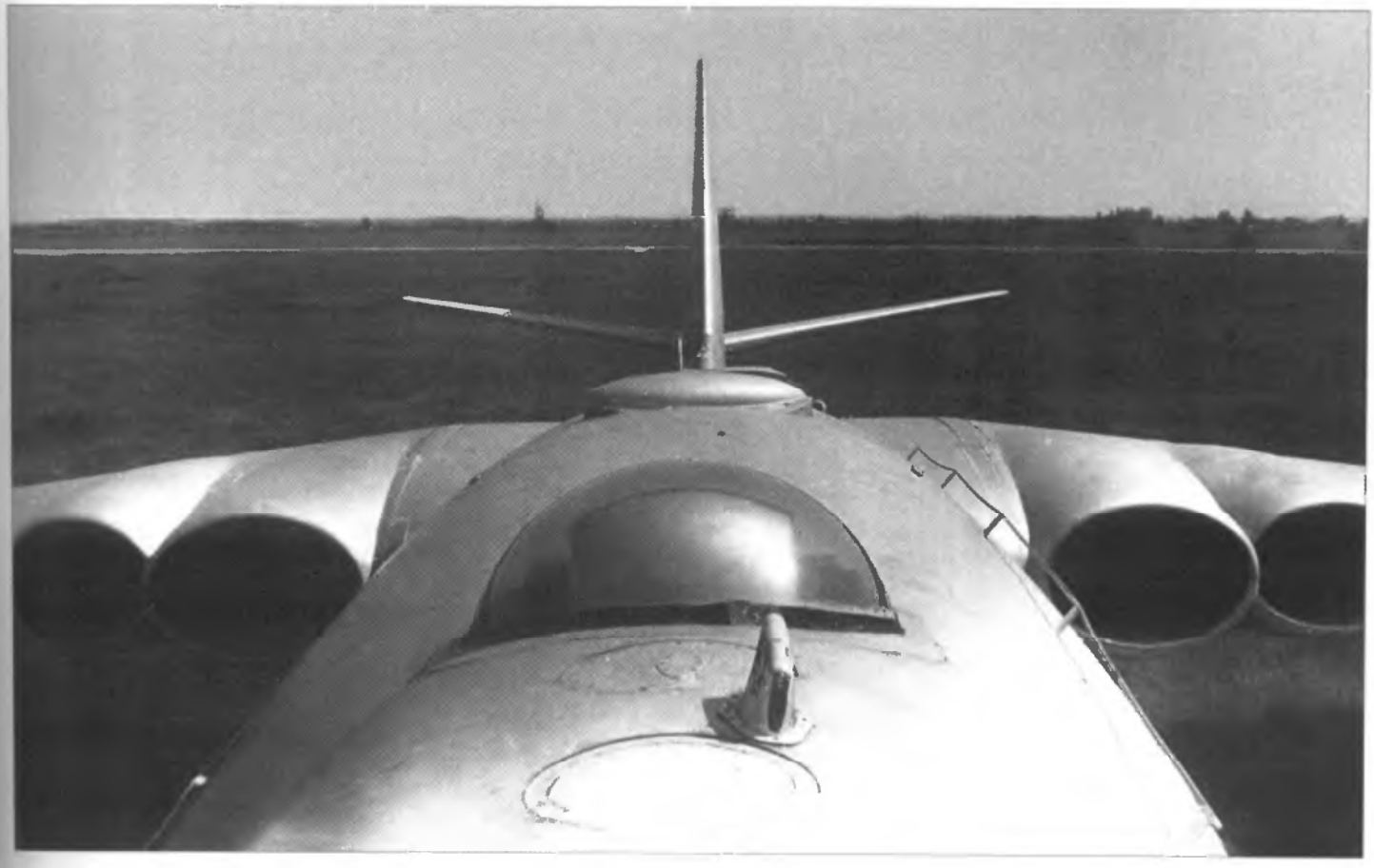
The extensively glazed navigator's station featured a cast magnesium alloy frame ***(Section F-1)*** with curved Plexiglas panels. These were double, the outer panes being 15 mm (19/32 in) thick and the inner ones 4 mm (5/32 in) thick; the air gap in between was provided with silica gel cartridges to prevent misting up. The optically flat elliptical lower panel and a small upper celestial navigation window used electrically heated triplex glass panes. The navigator's station featured an inward-opening direct-vision window on the starboard side. An unpressurised bay for the radar antenna enclosed by a chin radome was located beneath the navigator's compartment. The later 3M and subsequent versions featured an extended nose with greatly reduced glazing for the navigator's station; the extreme nose ahead of the navigator's station was a radar bay enclosed by a large dielectric radome blended into the nose contour which was apparently Section F-1 in this case.

The M-4's fuselage was of basically cylindrical shape.

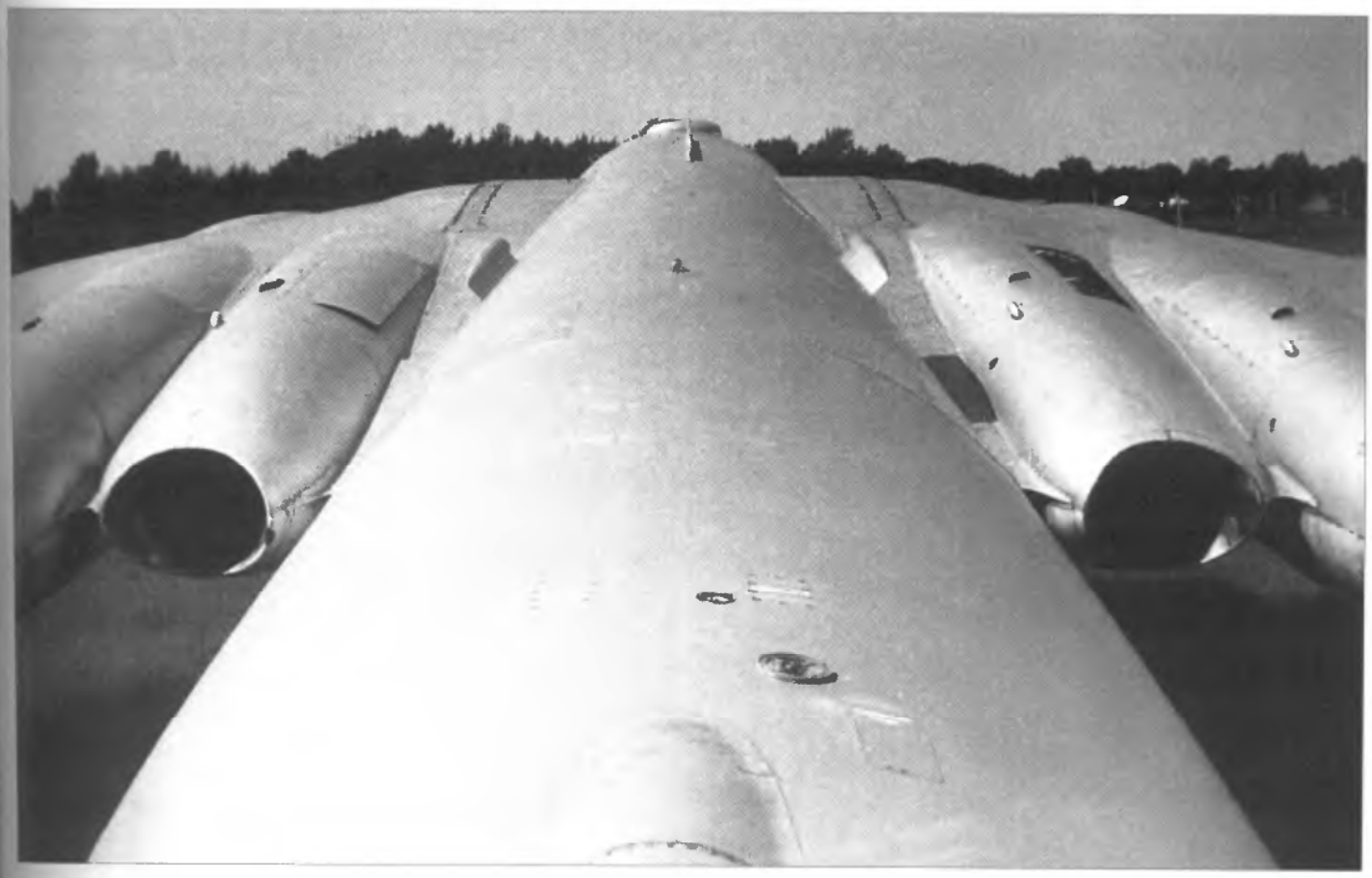


Above: The forward fuselage of M-4 '77 Red'. Note the aft-opening entry hatch and the hatches for the ejection seats on the lower fuselage sides.

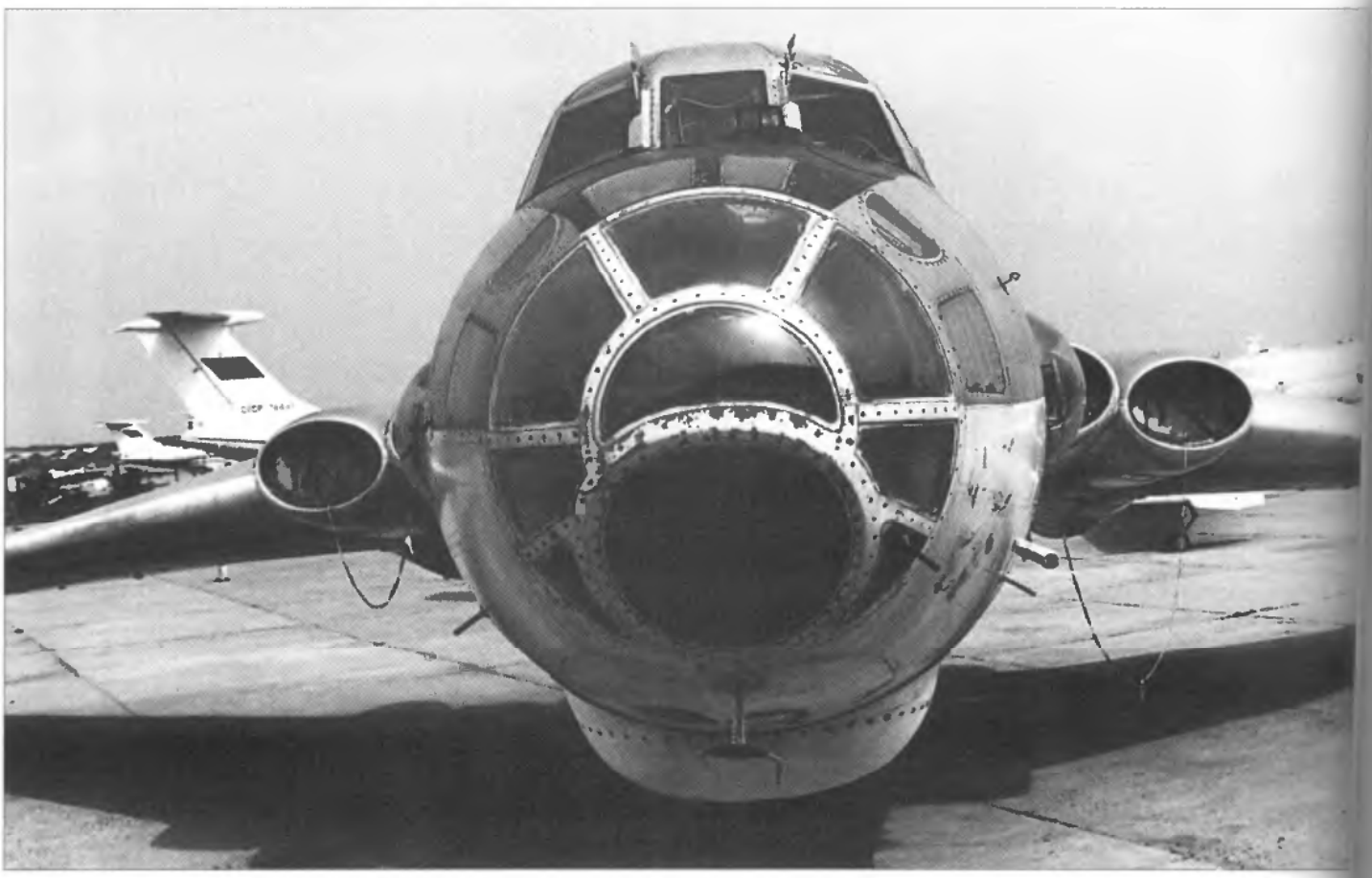
This view illustrates the characteristic 'hump' of the flightdeck roof, the dorsal navigation/sighting blister and the star tracker of the celestial compass ahead of the windscreen.



Above: View towards the M-4's tail from the flightdeck roof escape hatch, showing the dihedral of the tailplanes, the dorsal cannon barbette and the 'towel rail' aerial on the port side of the forward fuselage.

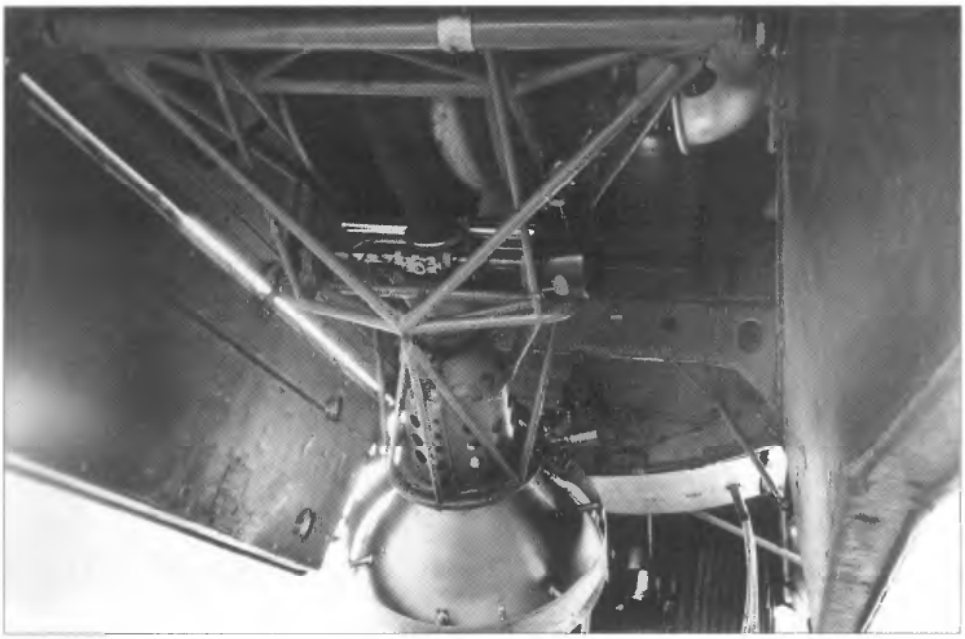


A view of the *Bison*'s mighty back, showing the shape of the engine nacelles. Some of the cowling panels are already missing on this retired example.



Above: An interesting head-on perspective of an M-4; as distinct from later versions, the *Bison-A*'s navigator enjoyed an excellent field of view. The civil aircraft (Il'yushin IL-76T CCCP-76497 and Tupolev Tu-t34A CCCP-65855) in the background belonged to the Myasishchev OKB.

Below: The open bomb bay of an M-4-2 tanker (or, equally possibly, a 3MS-2 or 3MN-2) showing the KAZ hose drum unit. The swivelling guide frame is tilted to the lower position from which the massive stabilised drogue is deployed.



The flightdeck glazing frame was welded from steel members, featuring optically-flat birdproof electrically de-iced triplex panes at the front and dual Plexiglas panes (with silica gel demisters) elsewhere. There were two sliding direct-vision windows. The flightdeck roof featured an escape hatch and a jettisonable blister made of 12 mm (15/32 in) thick Plexiglas to be used in the event of a belly landing or ditching. Two large Plexiglas blisters were located on the forward fuselage sides between frames 9-12 for gun aiming and observation.

The forward fuselage underside incorporated an aft-hinged entry hatch (frames 13-1 secured by twin locks and four escape hat covers which were jettisoned in the event ejection. The crew section floor and sidew were made of sheet duralumin armour.

The ***centre fuselage (Section F-4)*** w 23.7 m (77 ft 9 in) long, the internal struct comprising 55 frames placed at 500-mm (1 7⅝ in) increments and 60 stringers. (Od enough, there was no Section F-3.) It inc porated the bomb bay (frames 50A-63) a the wheel wells located fore and aft o (frames 27-41 and 65-76); the wing tors box carry-through structure passed betwe the nosewheel well and the bomb bay (fram 45-55). The bomb bay was closed by t doors which normally opened through 90° could be opened through 180° on the grou for loading/maintenance. Mainframes 30 31 served as attachment points for the n gear unit, while mainframes 71 and 72 co the main gear unit. Two hefty hollow rectangular-section beams set 1.8 m (5 ft 10 apart flanked the bomb bay and the wells, absorbing the structural loads in area.

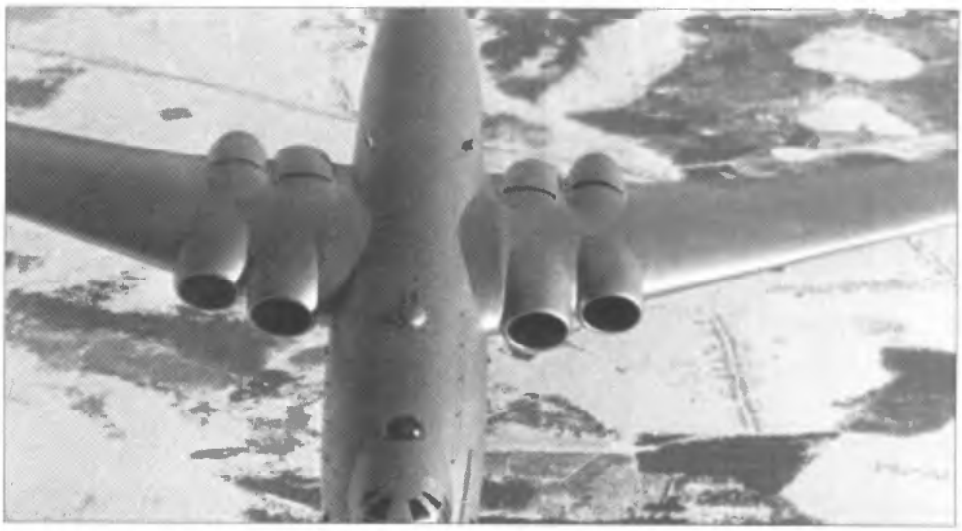
Bays housing the forward pair of fuse fuel cells were located in the centre fus between frames 17-27, 41-46, 46-51 and 76. A bay situated above the port for

fuel cell and closed by a detachable cover (frames 21-24) accommodated inflatable rescue dinghies with their CO_2 bottles, emergency food ration bags and paddles.

The tapered ***aft fuselage (Section F-5)*** was 13.2 m (43 ft 3⅝ in) long. It incorporated six bays for the rear fuselage fuel cells (frames 77-80 and 80-85), a strike camera bay (frames 86-88), a brake parachute bay (frames 103-107) and accommodated the tailplane trim jack, the rudder and elevator hydraulic actuators, the tail turret's ammunition boxes, ECM equipment and a DYa-SS stores cassette (*derzhatel' yashchichnyy sredstv signalizatsii* – 'box-type rack for signal means') holding flare bombs (frames 88-94).

The ***tail gunner's station (Section F-6)*** was a pressurised cabin 1.95 m (6 ft 4¾ in) long and 2.85 m (9 ft 4⅛ in) high which also incorporated the tail turret, its control system and gun ranging radar and other equipment. The tail gunner's station featured a ventral entry/ejection hatch (frames 122-115) hinged to starboard, a boarding ladder , three bullet-proof glass rear windows and four side windows with double Plexiglas panes.

The armour plating of the crew sections offered protection against 20-mm (.78 calibre) cannon fire and anti-aircraft shell fragments. It included homogeneous armour, cemented armour and aluminium anti-fragment armour. The pilots' and navigator/bomb-aimer's seats featured 10-mm (⅜-in) armoured seat pans and seat backs; the forward gunners were protected by armour 10-20 mm (⅜ to ¾ in) thick, while the tail gunner was shielded from behind by an armour plate forming the rear wall of his cabin and bulletproof glass panes 145 mm (5¼ in) thick. In order to minimise the weight penalty imposed by the armour its thickness was chosen with regard to the extra protection provided by non-critical airframe and systems components.



Above: This view shows the bomber's inner wings and engine nacelles. The fuselage is area-ruled at the wing/fuselage joint. Note the engine accessory cooling air intakes at the rear of the engine nacelles.

Wings: Cantilever mid-set monoplane of basically trapezoidal planform. Sweepback at quarter-chord 35°, anhedral 1.5° on the outer wing panels, incidence 2° 30', no camber. The wings utilised TsAGI P35-15 airfoils at the root

Below: Maintenance work in progress on a 3MS; the upper cowling panels on each engine are open and the fairing of the dorsal turret is removed, exposing the twin AM-23 cannons. This picture illustrates how the wing boundary layer fences were located on the 3M and subsequent versions.

Above: The tail unit of M-4-2 '65 Red' (c/n 4300306) at Engels-2 AB, showing the tailplane dihedral. The tail gunner's station is covered by a tarpaulin, which is standard practice in the Soviet/Russian Air Force.

and P36-12 airfoils at mid-span. Wing span 50.53 m (165 ft 9¼ in); wing area 258.0 m² (2,774 sq. ft).

The wings were all-metal, stressed-skin two-spar structures made of aluminium and magnesium alloy. Structurally they were made up of five pieces: the centre section (built integrally with fuselage section F-4), inner wing panels (***Sections K-1***, port and starboard, incorporating the engine bays; K = *krylo* – wing) and outer wing panels (***Sections K-2***, port and starboard). The trailing edge featured a pronounced kink at the inner/outer wing section joint. Each wing featured two boundary layer fences.

The basic structure was the torsion box formed by the front and rear spars, ribs and skin panels supported by stringers. The inner wing sections had 11 ribs each, the outer ones 20 ribs each. Ribs 1-5 on the inner wings were parallel to the fuselage axis, as the engine bays were located in between; all other ribs were at right angles to the rear spar. The leading-edge fairings were detachable, serving as de-icing system air ducts. The outer wings featured large cigar-shaped fairings housing the landing gear outrigger struts and doubling as anti-flutter weights.

The inner and outer wings were equipped with two-section TsAGI flaps (modified Fowler flaps) moving on internal curved tracks, these were augmented by simple hinged flaps under the centre section which were shaped to conform to the bottoms of the engine nacelles. The flaps were actuated by electric motors via extension shafts, angle drives and screwjacks (two for each hinged flap and two inboard/four outboard for the TsAGI flaps). Maximum flap deflection was 30° for landing. Large two-section ailerons were mounted outboard of the flaps (see Control system).

Tail unit: Conventional tail unit of all-metal stressed-skin construction; NACA-00M symmetrical airfoils were used for both fin and stabilisers. The ***vertical tail*** consisted of a fin and a one-piece rudder (see Control system). The fin was a two-spar structure with 23 ribs and detachable leading edge and tip fairings which was attached to the aft fuselage by 44 bolts and fittings; vertical tail sweepback at quarter-chord 35°, aspect ratio 1.96, taper 10.

The cantilever fixed-incidence ***horizontal*** tail consisted of two stabilisers and two-section elevators (see Control system). The stabilisers were joined by bolts on the aircraft centreline; each stabiliser was a two-spar structure with 22 ribs and detachable leading edge and tip fairings. Sweepback at quarter-chord 33.5°, dihedral 10°, aspect ratio 4.8, taper 2. The 3M and later versions had variable-incidence stabilisers with no dihedral; stabiliser incidence was adjusted by an electric screwjack located in the rear fuselage.

During their service careers 34 M-4 and 3M bombers had their wing and fuselage skins replaced with thicker ones to cope with increased loads. This modification, made in accordance with a Council of Ministers directive dated 13th March 1959, was patterned on M-4 '65 Red' (c/n 4300306) and 3M c/n 7300701.

Landing gear: Electrically-retractable bicycle type; all four units retracted forward by means of screwjacks. Emergency extension was effected by the emergency electric system; the units were extended one by one in any order.

The nose and main units were equipped with four-wheel bogies. The nose gear bogie had 1,700 x 550 mm (66.92 x 21.65 in) non-braking wheels; the forward pair was hydraulically steerable through ±4°, allowing the bogie to turn ±27° with respect to the aircraft centreline for taxying. The nose gear also featured a special hydraulic ram which tilted the bogie when a certain speed was attained during take-off so that the forward pair was lifted clear of the ground, this increased the angle of attack by 3°, facilitating lift-off.

The mainwheel bogie had wheels of the same size equipped with pneumatic brakes. The castoring outrigger struts were equipped with twin 660 x 160 mm (26.00 x 6.30 in) K2 non-braking wheels.

The starboard outrigger strut and wingtip fairing of M-4-2 '66 Red' (c/n 6302528). Note the extreme rearward incline of the strut in the static load position.

The nosewheel and mainwheel wells were closed by twin lateral doors. Each outrigger unit had twin main doors at the front and an auxiliary door hinged on the outboard side of the wingtip fairing. All doors remained open when the gear was down.

All landing gear struts featured oleo-pneumatic shock absorbers.

To shorten the landing roll the aircraft was provided with a three-canopy brake parachute system; total parachute area was 185-190 m² (1,990-2,043 sq. ft). The parachutes were stowed in a bay on the rear fuselage underside, deploying automatically at the moment of touchdown at 200-220 km/h (124-136 mph); they were released after the aircraft slowed down to 40 km/h (25 mph) to avoid damage caused by scuffing against the runway. The parachute deployment and release system was electro-pneumatically operated.

Powerplant: Early M-4s were powered by four Mikulin AM-3A turbojet engines rated at 8,750 kgp (19,290 lb st) for take-off and 6,200 kgp (13,670 lb st) for cruise; these were substituted by Zoobets RD-3M-500s or RD-3M-500As (derivatives of the AM-3A) with a take-off rating of 9,500 kgp (20,940 lb st) or 10,500 kgp (23,150 lb st) respectively on the M-4A, 3MS-1 and 3MS-2. The engine was manufactured by the Kazan' engine factory in 1952-63.

The AM-3 was an axial-flow non-afterburning turbojet with a fixed-area air intake, an eight-stage compressor, a can-annular combustion chamber with 14 flame tubes in a common shroud, a two-stage turbine and a fixed-area jetpipe with a conical centrebody. The air intake assembly featured six fixed inlet guide vanes and an extended ogival centrebody. For the first time in world jet engine design practice, the compressor was adjustable (bleed valves were provided for spilling excess air). The combustion chamber assembly featured throat vortex generators and ribbed flame tubes for better cooling.

Engine pressure ratio 6.2; mass flow at take-off rating 150 kg/sec (330 lb/sec). Turbine temperature at take-off rating 1,130° K. Specific fuel consumption (SFC) at take-off rating 1.0 kg/kgp·hr (lb/lb st·hr), cruise SFC 0.931 kg/kgp·hr. Length overall 5.38 m (17 ft 7¾ in), inlet diameter 1.4 m (4 ft 7⅛ in); dry weight 3,100 kg (6,830 lb).

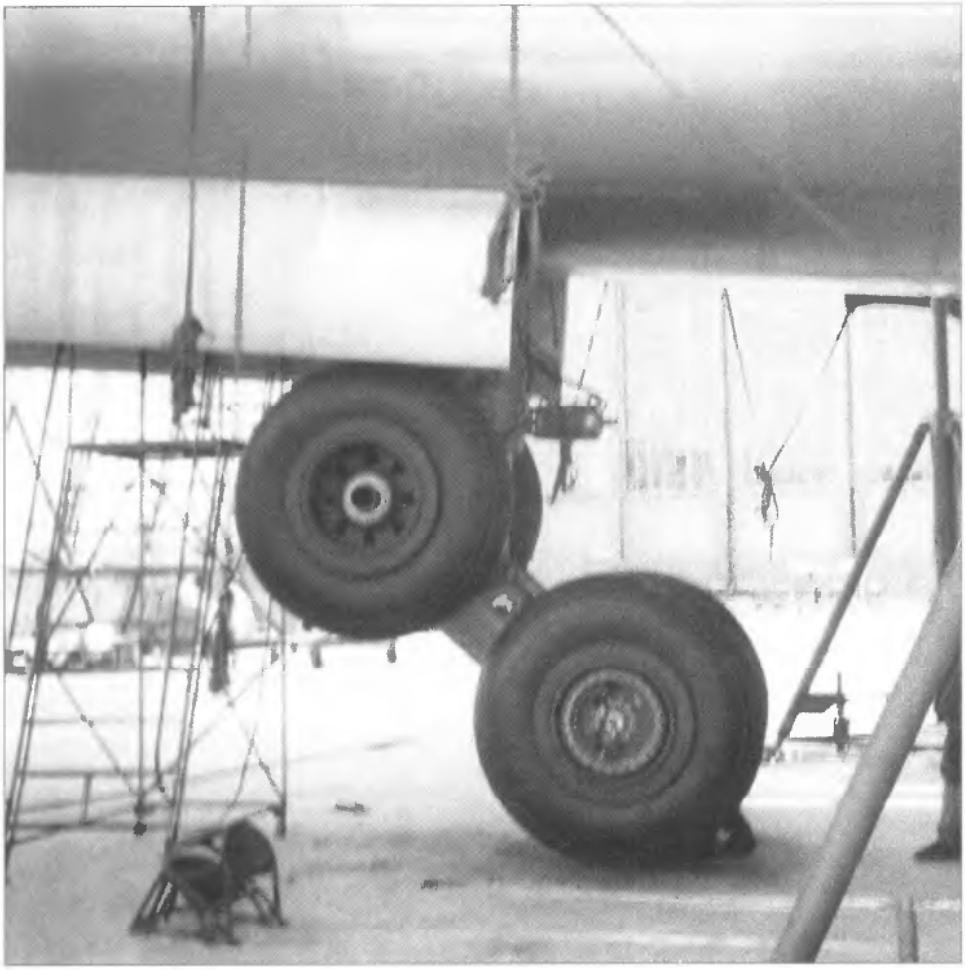
Each engine was started by an individual TS-300M jet fuel starter installed in the air intake centrebody and breathing through a small air intake at the front. The JFS drove the engine spool via a hydromechanical clutch. Maximum continuous power 65-75 kW at 34,000-35,000 rpm rotor speed.

The 3MN-1, 3MN-2 and 3MD were powered by Dobrynin VD-7B non-afterburning axial-flow turbojets rated at 9,500 kgp (20,940 lb st) for take-off.

Above: The main landing gear bogie of the M-4. Note the angle at which the mainwheel well doors open to avoid scraping the runway as the main gear oleo compresses at touchdown.

Above: Another view of the M-4's main gear unit. Note the recesses in the wheel well doors for the bogie's rear wheels and the ground power socket (with power cable connected) ahead of the wheel well.

The nose gear unit. The wheel size was identical on the nose and main gear bogies.



Above: This view of an M-4 trestled for landing gear retraction tests shows how the nose gear bogie tilted in no-load condition, raising the nose automatically on take-off. Note that the forward and rear wheels are of different models on this particular aircraft.

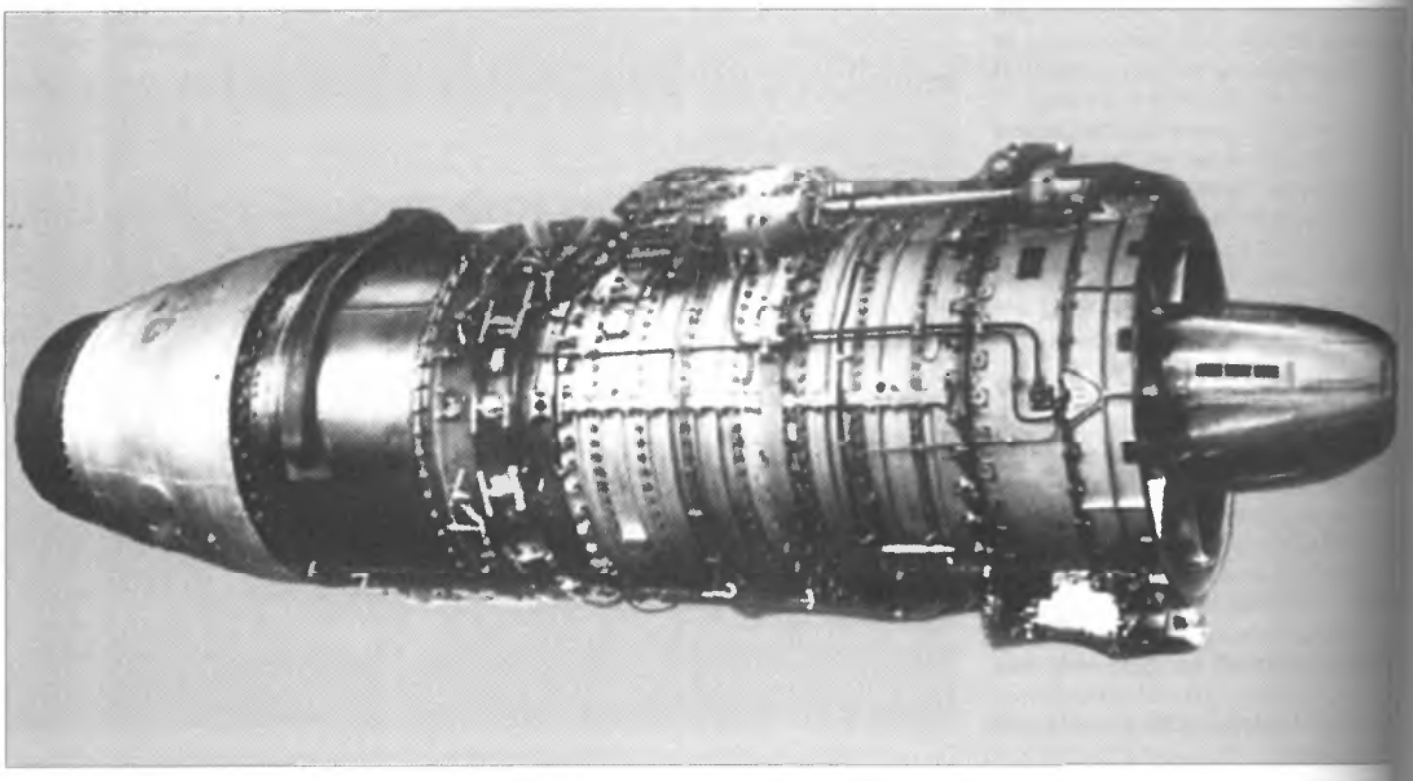
Below: The Mikulin AM-3 turbojet which powered most versions of the *Bison*. The elongated nose fairing with an air intake at the front housed an S-300M jet fuel starter.

The engines were buried in the wing roots, located in pairs aft of the rear spar in separate bays, ensuring adequate cooling of each engine and protection of the adjacent engine and airframe structure in the event of a fire. Each engine had its individual elliptical air intake, the inlet ducts passing through the wing spars. The intakes on each side protruded beyond the wing leading edge and were stepped to preclude harmful interference in various engine operation modes (including start-up and shutdown), the inboard ones being longer. Similarly, the jet-pipes protruded beyond the trailing edge in a stepped arrangement, the outboard ones being longer. The engines were angled 4° outwards and 4° down relative to the FWL to avoid the exhaust impinging on the rear fuselage sides and horizontal tail, which might cause fatigue problems.

Control system: Fully powered dual control system with manual back-up in an emergency; all control inputs transmitted by rigid push-pull rods, control cranks and levers. An AP-15 autopilot was fitted.

Roll control was provided by two-section ailerons on the outer wings; the inner and outer sections were linked by jointed shafts to make sure they moved in concert while precluding the possibility of jamming as the wings flexed. The ailerons had both aerodynamic and mass balancing and were slightly 'nose heavy'; the inner sections featured servo tabs doubling as mechanically controlled trim tabs. Each section was hinged on three brackets.

Pitch control was provided by two-section elevators. Each section was hinged on three



brackets, the inboard sections each incorporating a servo/trim tab. The elevators had both aerodynamic and mass balancing.

Directional control was provided by a one-piece rudder likewise featuring aerodynamic and mass balancing and incorporating a servo/trim tab at the root. The rudder was hinged on three brackets plus a lower support located aft of the fin torsion box.

The pitch and roll control circuits featured irreversible hydraulic actuators, whereas the directional control circuit included a reversible hydraulic actuator with a reduction ratio of 1:15. To provide feedback the pitch control circuit included an AU-2 automatic artificial feel unit (*avto**maht** oo**sil**iy*), with simpler spring-loaded mechanisms in the directional and roll control circuits. Each circuit featured a trim mechanism for reducing control forces.

Fuel system: On the M-4 the fuel system was divided into 18 groups of tanks, several groups being assigned to each engine. The groups were connected by means of a cross-feed valve, enabling each engine to draw fuel from any group of tanks.

All tanks were bladder tanks (fuel cells) located in bays in the forward and aft fuselage and in the wing torsion box. The fuel lines from the wing tanks were routed along the front spar. The fuel system automatically sequenced fuel tank usage to maintain the aircraft's CG within acceptable limits. Fuel jettison valves were provided under the outer wings and aft fuselage to reduce the all-up weight in an emergency.

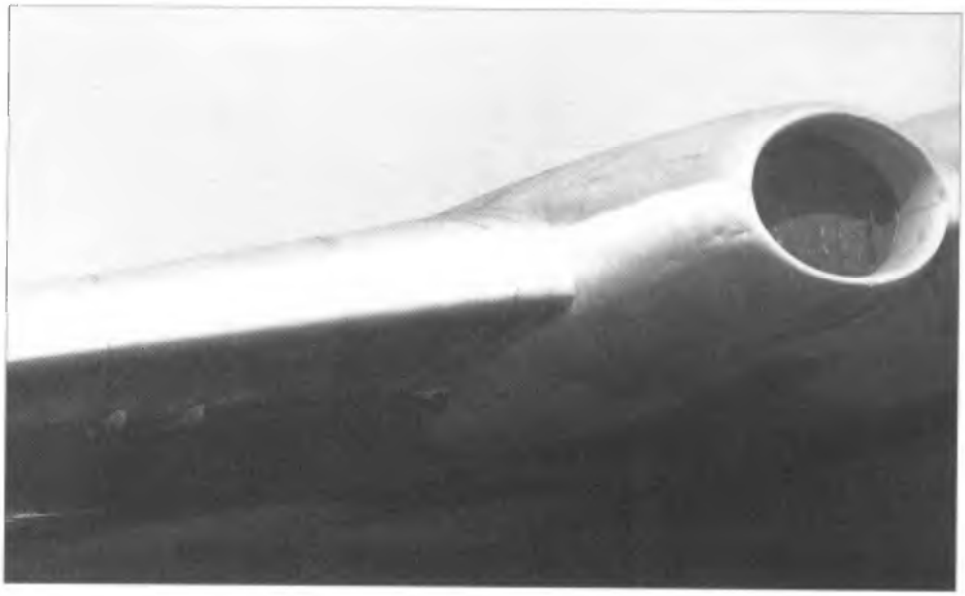
Theoretically, total fuel capacity was 132,390 litres (29,125 Imp. gal.); in reality, however, the aircraft could not take more than 123,600 litres (27,192 Imp. gal.). Two auxiliary tanks could be carried in the bomb bay for extra-long-range missions; the 3M and later versions could carry two 6,500-litre (1,430 Imp. gal.) drop tanks under the wing roots. The 3MS-1, 3MN-1 and 3MD introduced in-flight refuelling capability with a fixed IFR probe ahead of the flightdeck windscreen or, in the case of the 3MD, at the forward extremity of the fuselage.

The M-4 had single-point pressure refuelling. Fuel grades used were Russian T-1, TS-1 or T-2 jet fuel.

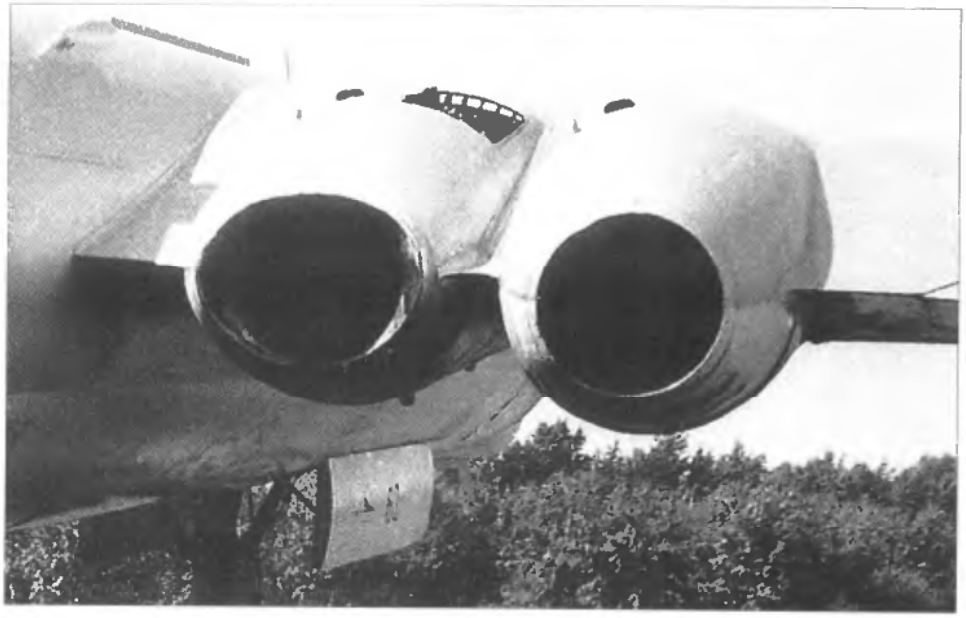
An inert gas pressurisation system was provided to pressurise the fuel tanks and reduce the hazard of explosion if hit by enemy fire.

Hydraulics: Three separate hydraulic systems (main system plus port and starboard control actuator power systems). Hydraulic pressure was supplied by two hydraulic pumps on each engine.

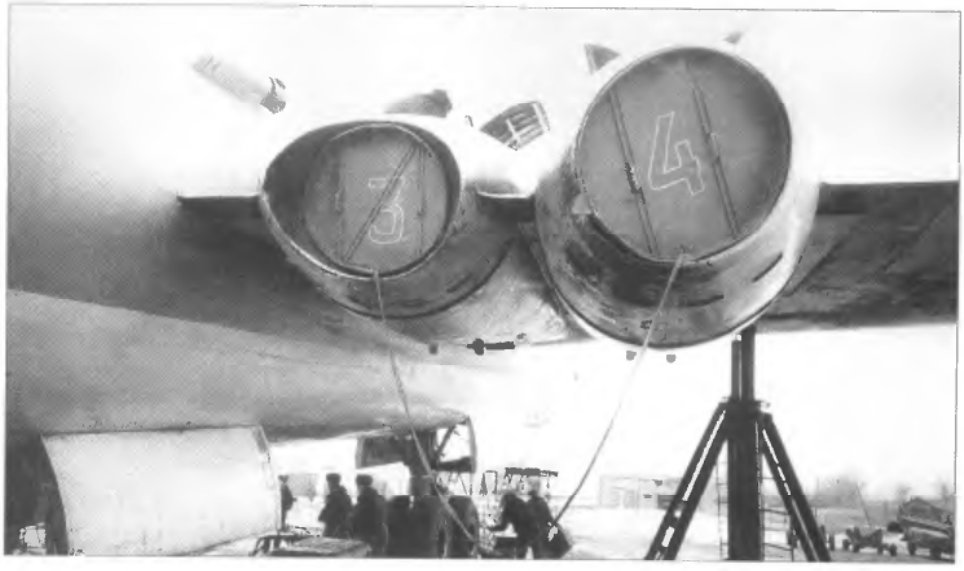
The main hydraulic system powered the wheel brakes, nose gear steering mechanism, bomb bay doors and windscreen

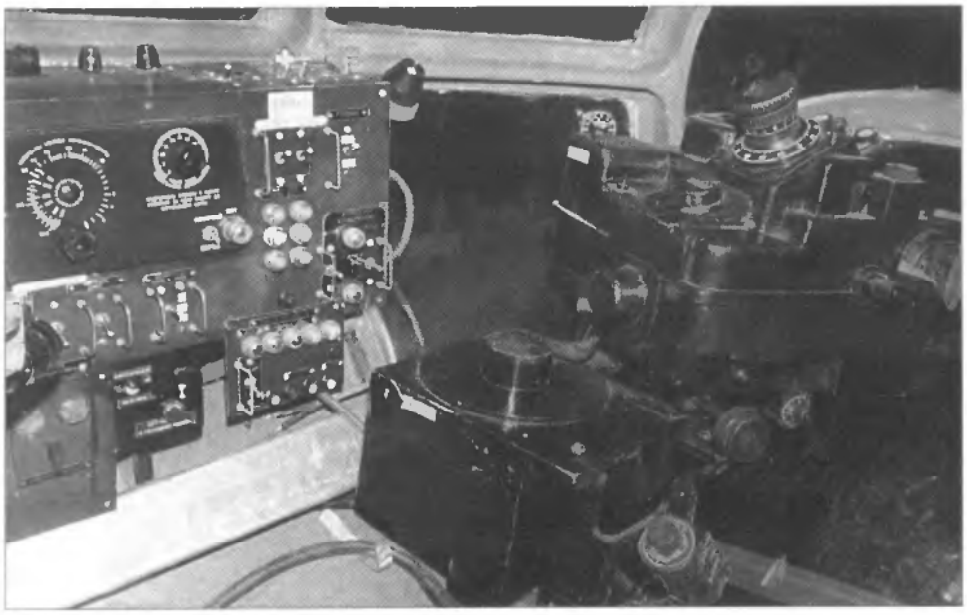


Above: The air intake of the No. 4 engine of an M-4.



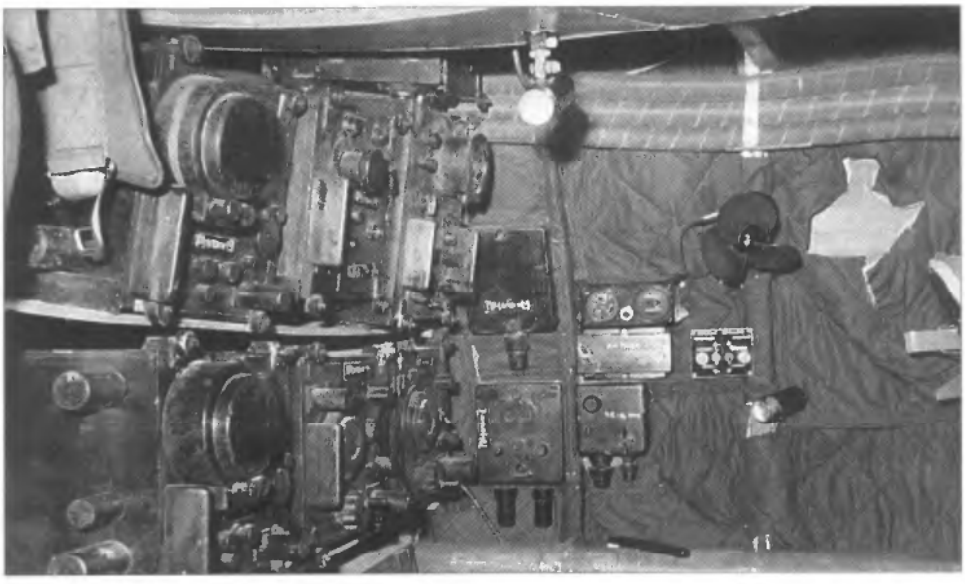
Above and below: The nozzles of the starboard engines of an M-4 (M-4-2 '63 Red', c/n 5301518 is pictured above). The inner and outer engines were installed in a staggered arrangement.





Above: The port control console and OPB-1 bomb sight in the navigator's station on the 'aircraft M' full-scale mock-up.

Above: The starboard side of the navigator's station on the 'aircraft M' mock-up.



The radar operator's workstation on the 'aircraft M' full-scale mock-up.

wipers. It also maintained pressure in two hydraulic reservoirs for emergency wheel braking and emergency bomb bay door actuation. Nominal hydraulic pressure 150 kg/cm² (2,140 psi).

The control actuator hydraulic systems powered the aileron, rudder and elevator actuators. It could also be used for emergency landing gear extension and nose gear steering if the main system failed. Nominal hydraulic pressure was likewise 150 kg/cm².

Electrics: DC power was supplied by engine-driven generators, with DC batteries as an emergency source. A ground power socket was located on the starboard side of the fuselage ahead of the mainwheel well.

Pneumatic system: The pneumatic system worked the seat actuators (which slid the seats towards the escape hatches prior to ejection), the entry and escape hatch perimeter seals, engine compressor bleed bands, de-icing system valves, wing flap uplocks, brake parachute door and release locks, flare bomb bay doors, dorsal blister emergency jettison ram and fuel jettison valves. It also served for emergency gear extension, pressurised the hydraulic reservoirs and the radar set, cocked the cannons and demisted the crew section glazing. Compressed air was supplied by two AK-150 engine-driven compressors on the inboard engines; nominal pressure was 150 kg/cm².

De-icing system: Hot air de-icing by engine bleed air on the wing, fin and stabiliser leading edges, engine air intakes and the auxiliary air intakes for the cabin pressurisation system, fuel tank vents and the AU-2 artificial feel unit. Electric de-icing on the flightdeck/navigator's station windows and pitot heads.

Radiation protection system: The airframe was adequately protected against the heat and flash of a nuclear explosion. The exposed portions of certain wing ribs served as attachment points and all internal structural elements visible from below were coated with a special high-gloss heat-resistant white enamel; so were the airframe undersurfaces (the tell-tale Soviet 'nuclear' colour scheme). The crew section glazing was sealed from the outside with a heat-resistant sealing compound. The aerials and dielectric fairings were coated with AS-2 enamel.

Fire suppression system: The airframe was divided into 11 'fire precincts' (fire protection zones) – seven for the various groups of fuel cells and one for each engine. The stationary fire suppression system comprised eight FUGOG-1 fire extinguisher bottles charged with carbon dioxide. The first shot was triggered automatically by flame sensors in the engine bays; all fire extinguishers could be fired manually by the flight engineer. The AZS-5 and AZS-10 fire suppression sys-

circuit breakers were installed on the pilot's electrics panel. There were also three portable CO_2 fire extinguishers.

Air-conditioning and pressurisation system: The crew cabins were pressurised by engine bleed air to ensure adequate working conditions at high altitude.

Crew escape system: All crew members were provided with cartridge-fired ejection seats which were rotated and propelled into a safe position for ejection by a pneumatic mechanism. All seats fired downwards and the seat harness was cut automatically when the seat was clear of the aircraft, allowing the ejectee to use his parachute. There were four ejection hatches in the forward pressure cabin and a separate hatch for the tail gunner. Ejection was possible singly in any order or simultaneously, except that the navigator/bomb-aimer and the two pilots were obliged to use the same hatch; therefore the navigator ejected first, followed by the pilots in any order.

In the event of a belly landing or ditching the crew evacuated the aircraft via the flightdeck roof escape hatch, the jettisonable upper blister and a hatch beneath the gun ranging radar mounted above the tail gunner's station. An LASM-49 rubber dinghy (*lodka avareeyno-spasahtel'naya modernizeerovannaya*) was stowed in a bay in the forward fuselage.

Avionics and equipment: The M-4 was fully equipped for all-weather day/night operation.

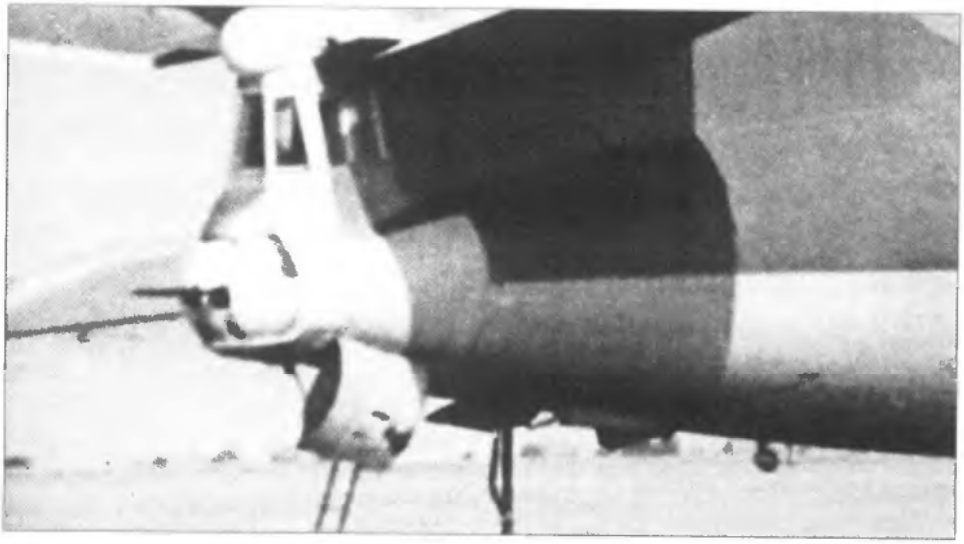
a) Navigation and piloting equipment: The navigation suite comprised gyroscopic, gyromagnetic, radio and celestial navigation systems. It included an RSBN-2SV Svod (Dome) short-range radio navigation (SHORAN) system with flush antennas built into the fin, a DISS-1 Doppler speed and drift sensor, an MRP-48 marker beacon receiver, a GPK-52 directional gyro (*gheeropolukompas*), RV-2 Kristall and RV-17 radio altimeters, two ARK-5 Amur automatic direction finders and an NI-50BN (aka ANU-1A) navigation display.

b) Communications equipment: 1-RSB-70 HF communications radio with a US-D receiver, a second 1-RSB-70 radio with a US-8 receiver, two RSIU-4V UHF command radios (main and back-up), served by dorsal and ventral blade aerials on the forward fuselage. A Kedr (Cedar) emergency radio was provided for sending distress signals. An SPU-10 intercom served for communication between crew members.

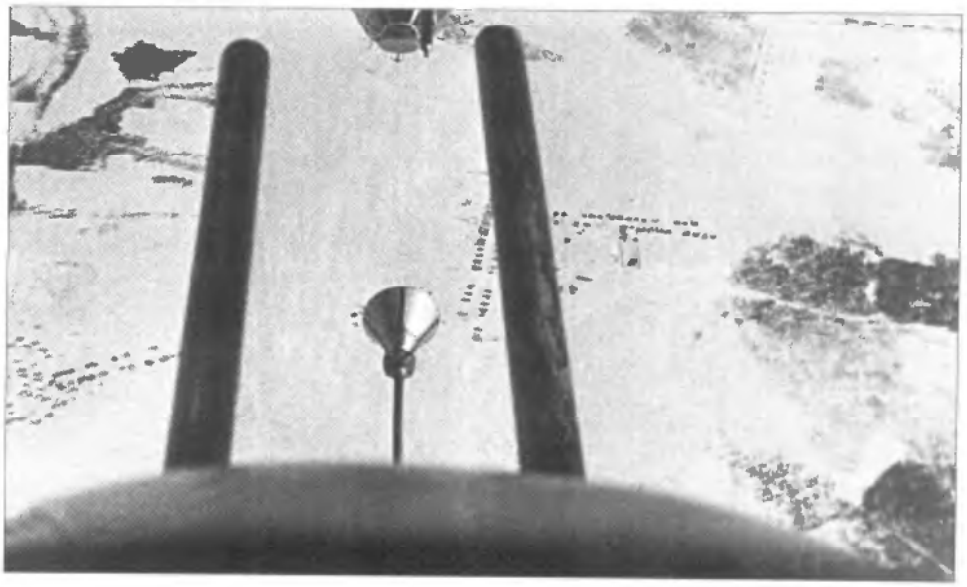
c) IFF system: SRZO-2 Khrom IFF transponder. The characteristic triple IFF aerials were located ahead of the flightdeck glazing and beneath the rear fuselage.

d) Targeting equipment: Navigation and accurate bomb delivery was enabled by an

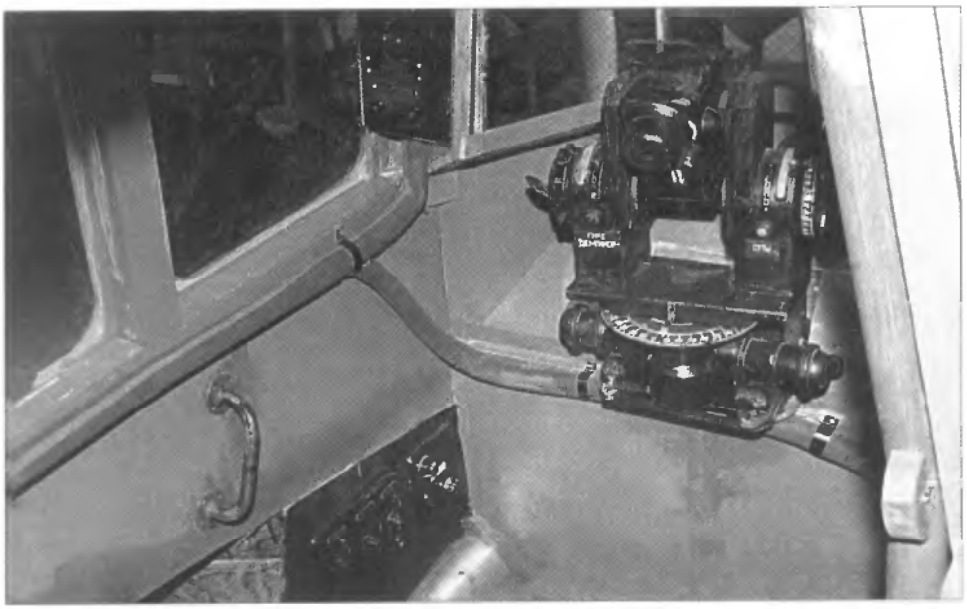
Above: An armourer loads a 23-mm ammunition belt into the ammo box of the ventral cannon barbette through special doors on the forward fuselage underside.



Above: The tail gunner's station of M-4-2 '64 Red' (c/n 5300407), showing the open entry hatch and access ladder and the radome of the gun ranging radar.



View from the tail gunner's station of the prototype M-4-2 (c/n 4300205), showing the tail cannons. The refuelling drogue is visible between them as probe-equipped M-4 c/n 4300104 comes in to make contact.



Above: The interior of the tail gunner's station of the 'aircraft M' full-scale mock-up, showing the PS-48 gunsight.

This view of a dead 3MN-1 is interesting in that it shows the crescent-shaped heat-resistant steel plates around the hole where the dorsal turret used to be; they protected the aluminium skin from the gun blast.

RBP-4 Roobidiy-MM-II panoramic navigation/ground mapping radar in a chin radome. The radar had two operating frequencies, which made for higher jamming resistance. Maximum accurate aiming range was 70 km (43 miles) and a large ground target could be detected up to 150-180 km (93-110 miles) away; the error margin was 75-100 m (250-330 ft) in range and 2° 30' in azimuth. Unlike its predecessor (which was handicapped by certain limits), the RBP-4 enabled bomb delivery throughout the M-4's operational envelope, ie, at speeds up to 1,250 km/h (776 mph) and altitudes between 2 and 15 km (6,560-49,210 ft). A special adapter linked the radar with an OPB-11S optical bomb sight. This was suitable for night operations, increasing bombing accuracy considerably.

Four optical gunsights were provided for the gunners – the VPS-53M dorsal sighting station (***verkh**nyaya **pritsel'**naya **stahn**tsiya*), the LPS-53M port beam sighting station (***le**vaya **pritsel'**naya **stahn**tsiya*), the PPS-53M starboard beam sighting station (***pra**vaya **pritsel'**naya **stahn**tsiya*) and the KPS-53M rear sighting station (*kormo**va**ya **pritsel'**naya **stahn**tsiya*).

Ranging and aiming the tail guns was done by means of a PRS-1 Argon gun-laying radar installed at the base of the rudder above the gunner's station. The radar had a 70° field of view. Importantly, it worked in concert with the IFF system, precluding 'friendly fire' incidents at night. The defensive armament system also included three PAU-457 gun cameras and a VB-53M ballistic computer.

e) Photographic equipment: A post-strike camera was installed in a bay in the rear fuselage.

f) Exterior lighting: Port (red) and starboard (green) navigation lights at the wingtips; white tail navigation light under the tail gunner's station. Three retractable landing/taxi lights on the flightdeck ventral entry/escape hatch and under the front ends of the main gear fairings. The 3M and later variants featured separate taxi lights on the nose gear doors. Triple four-round EKSR-46 signal flare launchers on the starboard side of the nose. Formation lights on the upper fuselage centreline for night flying. Aircraft equipped with an IFR probe featured drogue illumination lights built into the extreme nose to facilitate night contacts with the refuelling tanker.

Armament: The M-4 featured an SPV-25 defensive armament system comprising three powered turrets – a DB-33A dorsal turret, a DB-34A ventral turret and a DB-35AM tail turret. Each turret mounted a pair of 23-mm (.90 calibre) Afanas'yev/Makarov AM-23 (TKB-495) cannons. The rate of fire was 1,250-1,350 rounds per minute. The cannon were belt-fed; the ammunition supply was 30 rounds per gun for the dorsal and ventral turrets and 400 rpg for the tail turret, giving a total of 4,400 rounds. The ammunition boxes were located in the forward and aft fuselage.

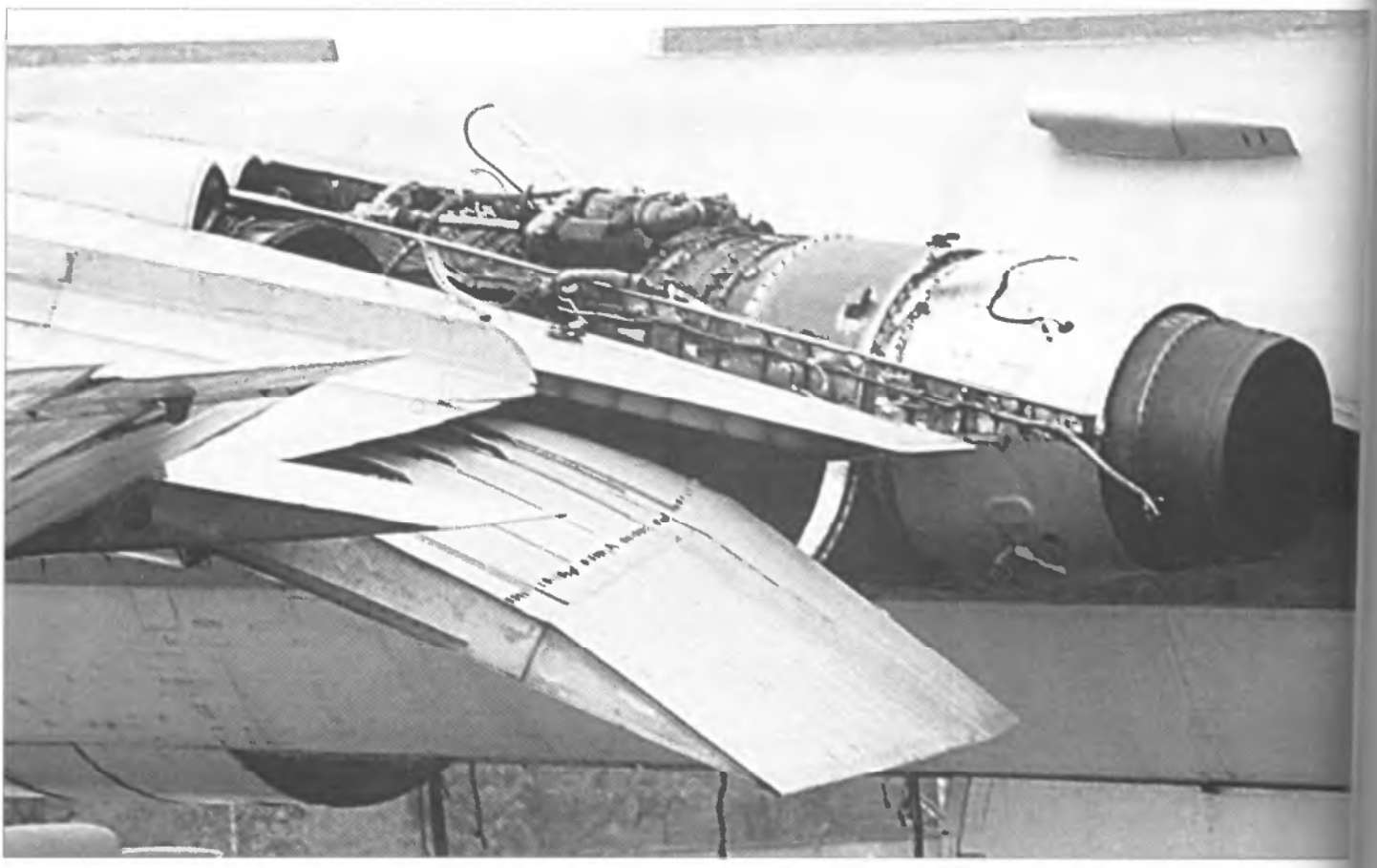
The offensive armament comprised nuclear or conventional (high-explosive) free fall bombs, torpedoes or anti-shipping mines. Possible payloads included four 6,000-kg (13,230-lb) BRAB-6000 armour-piercing bombs, two 9,000-kg (19,840-lb) FAB-9000 or 5,000-kg (11,020-lb) FAB-5000 HE bombs, six 3,000-kg (6,613-lb) FAB-3000 HE bombs, up to 28 500-kg (1,102-lb) FAB-500 HE bombs, or up to 52 250-kg (551-lb) FAB-250 or 100-kg (220-lb) FAB-100 HE bombs. For maritime missions the bomber could carry six Lira, Serpey, APM, AMD-2M or IGDM anti-shipping mines or RAT-52 rocket-propelled torpedoes.

In maximum payload configuration two FAB-9000s or four FAB-6000s were carried in a vertically staggered arrangement. Alternatively, if one FAB-9000 was carried it was suspended in a slightly nose-down position, and this end the bomb bay doors were bulged.

For target illumination purposes two KD MP racks (KD = *kas**set**nyy **derzhah**tel'* – cassette-type rack) were installed in a DYa-SS cassette in the rear fuselage. These could hold two FotAB-100-80 flare bombs (*fotograficheskaya **avia**bom**ba***) or one FotAB-250-215. Two more DYa-SS cassettes, each housing six TsOSAB coloured marker/signal flare bombs (*tsvet**na**ya oriyen**teer**no-signahl'naya **avia**bom**ba***) or OMAB maritime marker bombs (*oriyen**teer**no-**mar**kernaya **avia**bom**ba***) were housed in the same bay.

Above: 3MD '49 Red' at Moscow-Domodedovo on 9th July 1967. This view illustrates well the *Bison-C*'s different forward fuselage design.

These two rear views of the 3MD show the zero-dihedral stabilisers and details of the tail turret.



Above: This view of a retired 3MS-2 tanker shows how the engines could be exposed completely for heavy maintenance or removal. The No. 1 engine is already gone. The photo also gives details of the flap design.

Left: Two 5,000-kg (11,020-lb) FAB-5000 bombs are towed on handling dollies to the hardstand by a *Bison* unit prepares for the day's training. The regiment boasts one of the nine production 3MDs most probably flown by the unit's CO.

Chapter 5

Combat Duty

As already mentioned, the world became aware of the Soviet Union's new giant jet bomber on 1st May 1954 when the first prototype M-4 streaked over Moscow's Red Square during the traditional May Day parade in company with four MiG-17s. Heated discussions about the Soviets' new wonder weapon broke out in the Western press. For a while the West hadn't the foggiest idea who was responsible for the bomber, and one source misidentified the aircraft as the Il'yushin IL-38! (This designation was later found to belong to an anti-submarine warfare aircraft based on the IL-18 *Coot* four-turboprop airliner and code-named *May*.)

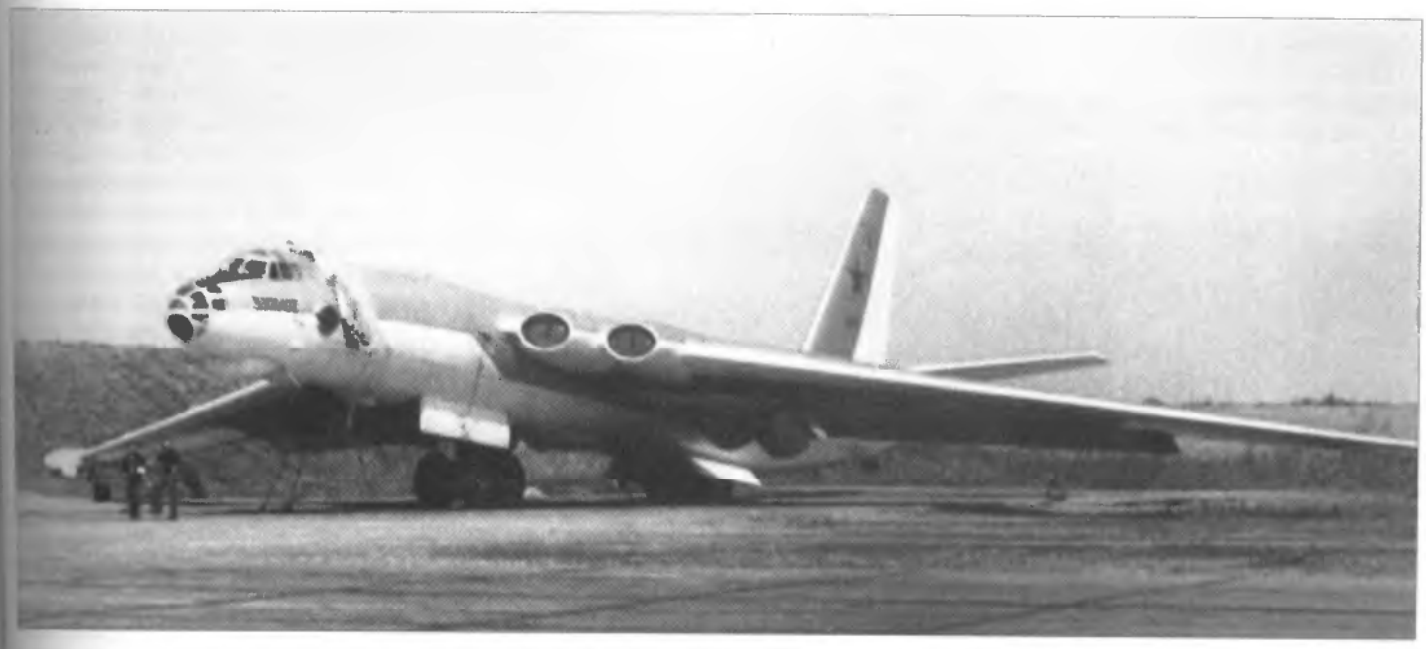
Western experts rightly concluded that the aircraft unveiled on May Day 1954 was a high-altitude long-range bomber. The wing span was estimated as 48-52 m (157 ft 5¾ in to 170 ft 7¼ in), which was not too far from the truth. However, it was presumed that the turbojet engines buried in the wings were rated at about 6,800 kgp (14,990 lb st) each, that the aircraft had a maximum design speed of about Mach 0.95 and a take-off weight of about 113.5 tons (250,220 lb). The weight and thrust estimates turned out to be way off the mark. Little did the Western experts know that the Russians could create a turbojet delivering 8,750 kgp (19,290 lb st); nothing in the same league existed then on the West's side of the Iron Curtain.

The units operating the M-4 included the 1096th and 1230th TBAPs (*tyazhe**lo**bombardi**rov**ochnyy **avia**pol**k*** – heavy bomber regiment). Service pilots of the Soviet Air Force's long-range bomber arm (DA – ***Dahl'**nyaya avia**h**tsiya*) were wary of the M-4 at first. A lot of surprise and even downright rejection was caused by the wingtips flexing up and down in flight – sometimes a dozen feet or more. This aeroelasticity sometimes startled the crews. On one occasion when the bomb armament was being tested during the evaluation period at Engels AB, the aircraft unexpectedly dumped the entire bomb load instead of dropping just one bomb as planned; the force acting on the aircraft was so great that the wings bent, propelling the aircraft upwards like a springboard! All attempts to get to the heart of the problem on the ground failed and the crew, being rather shaken, did not want to push their luck.

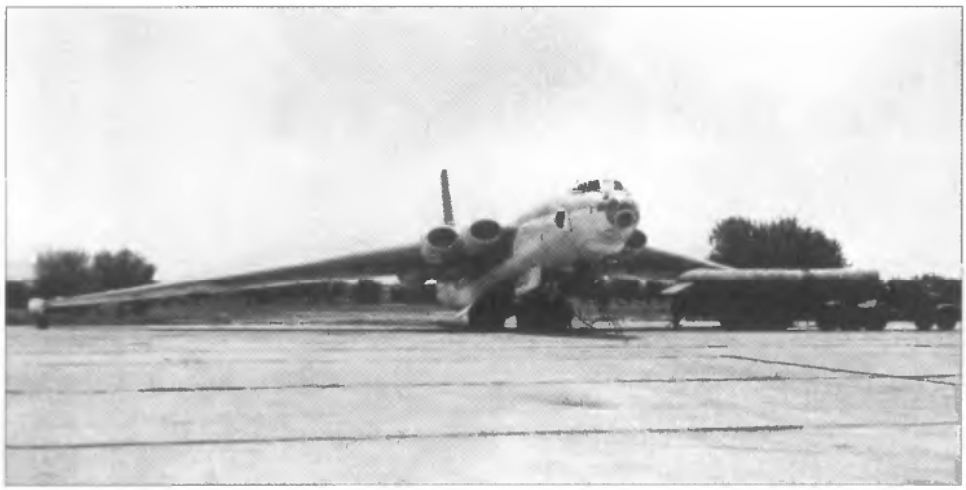
GK NII VVS Chief Navigator Col. A. N. Rekoonov rushed off to Engels AB to take the matter in hand. After analysing the incident he took the decision to fly a sortie. The heavily loaded bomber took off, heading for the local weapons range. The first drop went normally but on the second attempt the scenario was repeated – the bomber's wings creaked threateningly under the sudden stress as the entire remaining load of heavy-calibre bombs tumbled earthwards. It was obvious that continuing the trials was too dangerous. The defect was eventually traced to a seemingly minor error – the wires in the bomb release control circuit had been cross-wired to the wrong connectors. This again proves the old adage: in aviation there are no trifling matters!

Pretty soon the M-4s (and later their 3M stablemates) started venturing out over international waters. These missions were a 'show of force', demonstrating the Soviet Union's military power to the West. The *Bisons* and other Soviet bombers frequently 'harassed' NATO naval task forces and skirted the maritime borders of NATO nations and Japan. Apart from the 'harassment' bit, these sorties involved an extremely important photo reconnaissance mission, including night-time reconnaissance. To this end the M-4 featured a tilting camera mount with AFA-42 day cameras (*aero**fot**oappa**raht*** – aerial camera) or NAFA-MK night cameras (*noch**noy** aero**fo**to**appa**raht***) aft of the mainwheel well, while a fairly large bay further aft housed flare bombs.

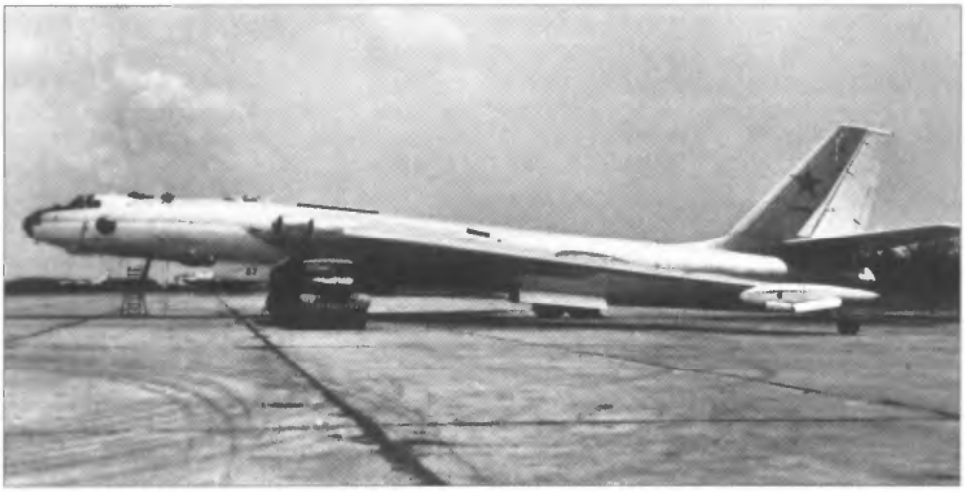
The bomber's main mission was the destruction of key military and industrial ground targets. It has to be said that, should



M-4 '10 Red' (c/n 5300407) rests between missions. This aircraft was later recoded '64 Red' and became an M-4-2 tanker.



Above and below: 1230th APSZ M-4-2 '62 Red' is refuelled by a TZ-22 fuel bowser – a 22,000-litre (4,840 imp. gal.) tank semitrailer towed by a KrAZ-258 lorry – at Engels-2 AB.



it be lucky enough to reach the target, the M-4 would blow it away like a tropical storm wiping out a straw hut. Standard armament options included two 'special munitions' (a euphemism for nuclear bombs), two 9,000-kg (19,840-lb) FAB-9000 high-explosive bombs (*foogahsnaya aviabomba*) or four 6,000-kg (13,230-lb) FAB-6000 HE bombs. Smaller bombs or torpedoes could also be carried on cassette- or bridge-type racks. If one FAB-9000 was carried, the bomb bay also accommodated two long-range fuel tanks – the so-called Group 12 tanks.

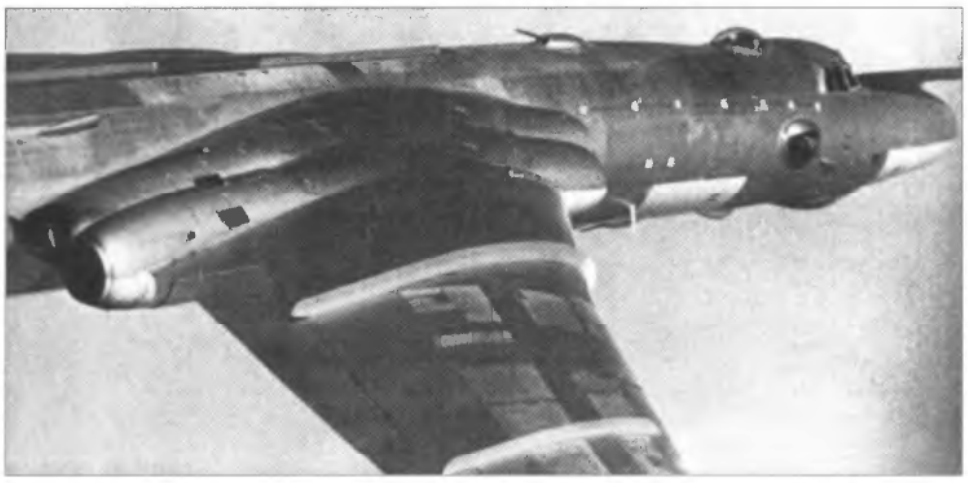
As already mentioned in Chapter 2, the Boeing B-52 entered flight test in 1952. A comparison of the initial-production B-52A and the M-4 shows that the two bombers possessed broadly similar performance, except for the service ceiling. The B-52's higher payload/weight ratio and take-off weight (204 tons/449,735 lb versus the M-4's 164 tons/405,640 lb) also gave it slightly longer range. The American bomber's service ceiling was nearly 5,000 m (16,400 ft) higher, which was considered an important advantage for air defence penetration purposes in the 1950s. The only area in which the B-52 was inferior was the defensive armament which initially consisted of only two 12.7-mm (.50 calibre) machine guns in a tail barbette.

Now we come to the big question: Could the *Bison* penetrate the air defence system of the 'potential adversary' (the NATO nations)? The numerous radar pickets, surface-to-air missile (SAM) sites and the supersonic interceptors stationed in Western Europe and North America virtually negated any chances of getting through, even in a first-strike scenario. The six cannons of the M-4 would hardly give it enough protection. The only hope for the bomber's crew lay in the SPS-2 active jammer (***stahn***tsiya po***mekh***ovykh signahlov – lit. 'interference signals emitter'), the chaff dispensers and the armour plating protecting the crew against shell fragments.

The service introduction of both the M-4 and the 3M was by no means trouble-free and was accompanied by a good number of accidents and incidents. For instance, on the *Bison-A* there were two cases of the elevator skin ripping away in flight; fortunately on both occasions the crew managed to land the aircraft in one piece. This dangerous defect was cured by altering the elevator design and stiffening the elevator control rods.

Fatal and non-fatal accidents occurred both during tests and in service. For instance, on 21st March 1955 the forward crew cabin of M-4 c/n 5300609 (serial unknown) decompressed at 5,000 m during a test flight from Zhukovskiy. Test pilots L. P. Vinogradov and L. V. Soomtsov brought the bomber home and attempted a landing but were foiled by a sudden blizzard. After three unsuccessful attempts the aircraft made an off-field forced landing, touching down fast and breaking up. navigator/radar operator Leonov lost his life.

On another occasion a hydraulic reservoir failed just as an M-4 captained by the famous test pilot Mark Lazarevich Gallai was about to become airborne. The massive cast-iron reservoir burst like a bomb, inflicting great damage; quite apart from the obvious failure of the back-up hydraulic system, the fragments severed the rudder control runs and the No. 3 engine's fuel line, punching numerous holes in the lower fuselage skin as they went. (Seeing this, a radio operator watching Gallai's take-off from the control tower at Zhukovskiy uttered in bewilderment, 'Something's just shot out of them!') As soon as the bomber became unstuck it veered sharply to one side because of the inoperative rudder. Gallai had to wait until he had got up to and



This air-to-air of a 3MN-1 (note the square orifices on the engine cowlings identifying the VD-7B engines) was probably taken during a test flight, as the aircraft lacks the characteristic all-white belly.

50 m (165 ft) before he could counteract the turn by banking the aircraft the other way. As he did, the No. 3 engine quit and the tail gunner reported there was a serious fuel leak ('like a fountain') from beneath the fuselage.

With extreme caution the pilots turned the stricken bomber around for an emergency landing. Care had to be exercised in handling the throttles because the exhaust plume changed its shape as the engines were throttled back and could ignite both the aircraft and the pall of kerosene mist stretching for hundreds of feet behind it – and then the chances of survival would be very slim indeed. As the aircraft touched down the flight engineer shut down the outer engines to reduce the fire hazard; the No. 2 engine could not be shut down just yet because it drove a hydraulic pump, providing hydraulic power for the brakes. Gallai ordered it shut down as the aircraft lumbered to an almost complete halt on the hardstand, but even that was a bit too early, as it turned out. The inertia of the huge bomber was such that it flattened the wheel chocks with a crunch and crawled on; it could not be stopped until it collided with the stripped-out hulk of another aircraft, slightly damaging the wing leading edge. It was only thanks to the test crew's experience and profound knowledge of the aircraft that the flight ended so fortunately.

On 16th June 1955 M-4 c/n 5301013 (serial unknown) was not so lucky. A fuel leak in one of the engine bays caused an in-flight fire; the burning bomber made it back to base but crash-landed 500 m (1,640 ft) short of the runway threshold, killing one of the crew.

Two months later, on 25th August 1955, M-4 c/n 5301417 (serial unknown) became airborne with a slight right bank after a take-off run of some 1,500 m (4,920 ft). The bank steadily grew, reaching 60-80° by the time the aircraft climbed to 25-40 m (80-130 ft; eyewitness accounts varied), whereupon the *Bison* side-slipped, crashed and burned, killing the crew of seven captained by I. P. Pronin. Pilot error was cited as the cause, but the underlying reason was the M-4's insufficient roll stability at critical angles of attack reached when the nose gear bogie tilted during rotation.

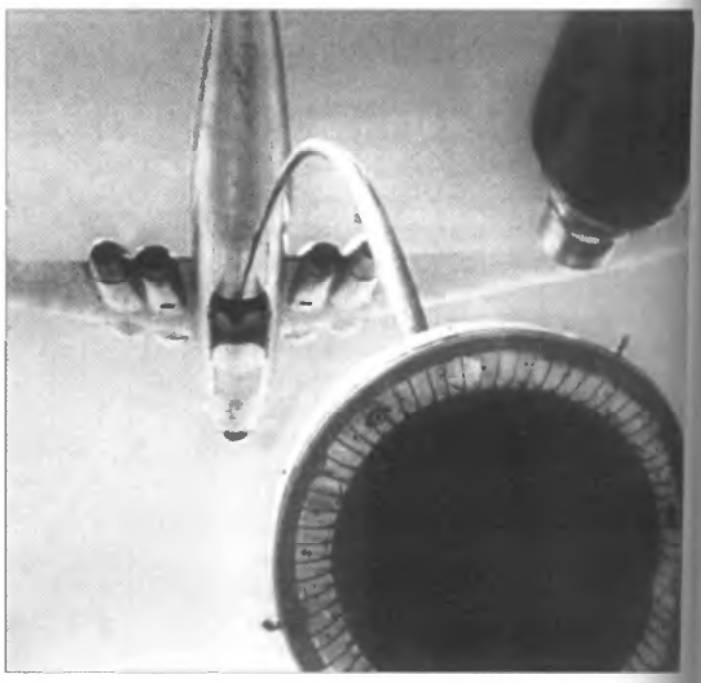
Almost a year later, on 26th June 1955, M-4 c/n 5300912 (serial unknown) crashed in similar circumstances while taking off from Engels-2 AB. Immediately after take-off the 150-ton (330,690-lb) aircraft climbed too sharply, reaching an altitude of 20 m (65 ft) instead of the 3-5 m (10-16 ft) that was appropriate at that point before it stalled and crashed, killing all on board. The worst part was that the aircraft was captained by the regiment's CO, Col. Verbitskiy, whose death was a sore loss for the unit. The cause of the crash was never determined because the M-4 had no 'black boxes' (flight data recorder and cockpit voice recorder) and the members of the accident investigation panel voiced conflicting views. The Air Force's representatives claimed that the prescribed take-off procedure had been observed and that the tilting bogie nose gear unit was the culprit; conversely, the aircraft industry spokesmen blamed the crew.

Routine maintenance on an M-4; the maintenance platform is noteworthy. The placard in front reads, 'Aircraft under electric power. All work must proceed under the supervision of the technician in charge'.

On 23rd August 1957 M-4 c/n 5302023 (tactical code unknown) crashed near Omsk in West Siberia, killing the crew of eight. Again debate raged as the VVS and the aircraft industry hurled accusations at each other, one side claiming the hydraulic control actuators had jammed and the other side stating pilot error was the cause, but the truth was never established.

By the end of 1957 the Myasishchev OKB apron at Zhukovskiy was clogged with up to thirty M-4s requiring modifications for flight safety reasons. The situation was so grave that on 30th December 1957 the Council of Ministers issued grounding orders for the M-4 until all defects had been rectified.

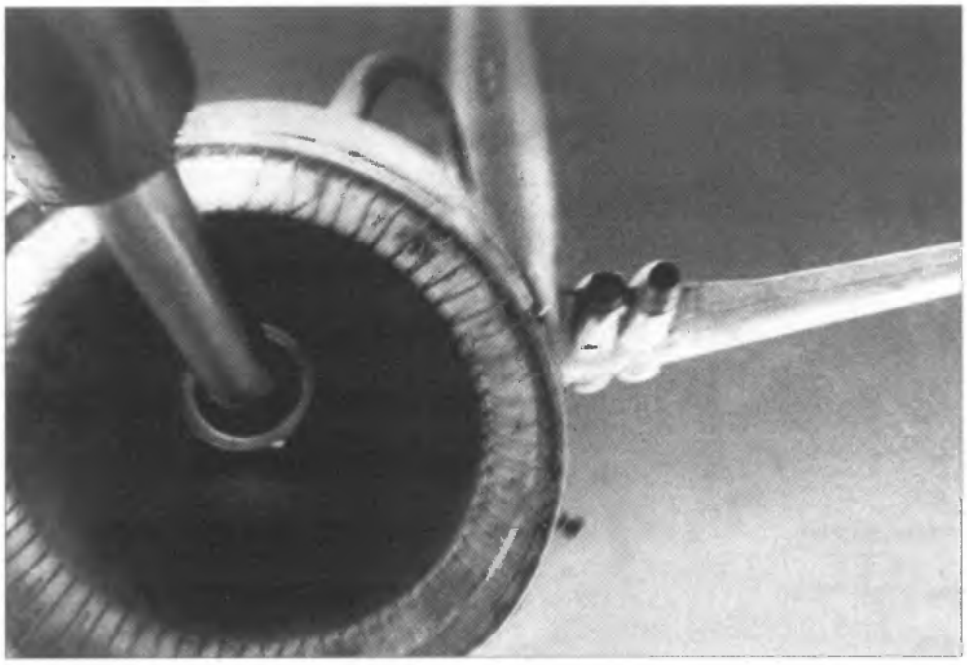
Still, attrition continued. On 18th March 1958 the final production M-4 (tactical code unknown, c/n 6303235) was lost during a training sortie at LII's airfield. The aircraft was taking off in manual control mode (with the hydraulic control actuators switched off); as it became airborne the wind suddenly changed. The rudder trim tab deflected almost fully, causing an uncommanded rudder hardover which the pilots were unable to counter; the aircraft executed an uncontrollable turn to port and crashed. Crew captain Sergey F. Mashkovskiy, co-pilot Eduard N. Ponomaryov, navigator I. F. Ovcharenko and three other crew members died in the blaze; only the radio operator survived.



Above: Receiver's eye view of an M-4-2 tanker as seen by the pilots (left) and the navigator (right). Note how the slipstream and the weight of the heavy drogue cause the fuel transfer hose to curve; there is no danger of it breaking away from the drogue because a special joint is provided there.

It should be noted that, while the Myasishchev OKB had taken precautions against the unreliability of the day's hydraulic control actuators by incorporating the manual control mode, flying the M-4 in this fashion was no piece of cake. Even after the surviving M-4s and 3Ms had undergone a mid-life update in 1957-58 to facilitate flying in manual mode, the forces on the aileron control wheels at 450-500 km/h (280-310 mph) exceeded 40 kgf (88 lbf).

The upgraded 3M was no better than the M-4 from a flight safety standpoint. The first *Bison-B* (tactical code unknown, c/n 6300303 or 6320303) crashed on 22nd November 1957 when the crew attempted to take off with the control gust locks still engaged; there were no survivors. The second major accident occurred at GK NII VVS on 14th February 1958 when the wheel brakes of 3M c/n 7300704 overheated during taxying, causing the hydraulic fluid to catch fire. The fire quickly engulfed the entire aft fuselage and tail unit; despite all the efforts of the fire crews, the entire airframe structure aft of the wings burned out before the blaze could be extinguished. Nevertheless, it was decided to rebuild the aircraft; trials at GK NII VVS continued with another 3M coded '25 Red' (c/n 7300802) supplied as a replacement.



The telescopic probe fires and the tip locks into the drogue in this view.

On 20th September 1958 the first production 3MN-1 (tactical code unknown, c/n 7300901 or 8300901) was ground-running one of its VD-7B engines when the first compressor stage tossed a blade. The resulting massive fire destroyed the aircraft completely and at least one person died.

According to the Air Force, *Bison* accident attrition was mostly caused by serious design shortcomings which came to light in the course of operational service. Six of the 50 production *Bison-As* – ie, nearly 20% of the production run – were lost in accidents. True the Myasishchev OKB did its best to improve the operational safety and reliability of the M-4 and 3M by making changes to the flight control system, the gust locks, the fire suppression system, the ejection seats and by improving the crews' working conditions.

As the 1950s drew to a close and a new decade began, certain factions in the VVS and the aircraft industry grew increasingly vocal, questioning the advisability of having two heavy bomber types in the inventory, especially now that the Tu-95K *Bear-B* missile carrier was available. This sparked the decision to convert a substantial proportion of the *Bison* fleet for the IFR tanker role; these tankers would support the operations of the Tu-95K and the remaining 3MS-1 and 3MN strike aircraft. The conversion programme proceeded as a joint effort by aircraft factory No. 23, the Air Force's aircraft overhaul plant No. 360 at Dyagilevo AB and the technical staff of the bomber division based at Engels AB which operated the *Bisons*. Thus the 1230th TBAP became the 1230th APSZ (*aviatsionnyy polk samolyotov-zaprahvshchikov* – aviation refuelling regiment). Although the conver-

jobs were a bit crude, the tankers showed an adequate flight safety record and fairly high performance – they could transfer up to 46 tons (101,400 lb) of fuel while having a combat radius of 5,500 km (3,420 miles).

Indeed, tanker operations were so intensive in those days that the industry could not supply enough replacement fuel transfer hoses, which had a limited service life. The VVS command had no choice but to extend the hoses' service life; on occasion this led to the hoses snapping in the middle of the refuelling operation (such dangerous incidents were recorded, eg, in 1973 and 1983).

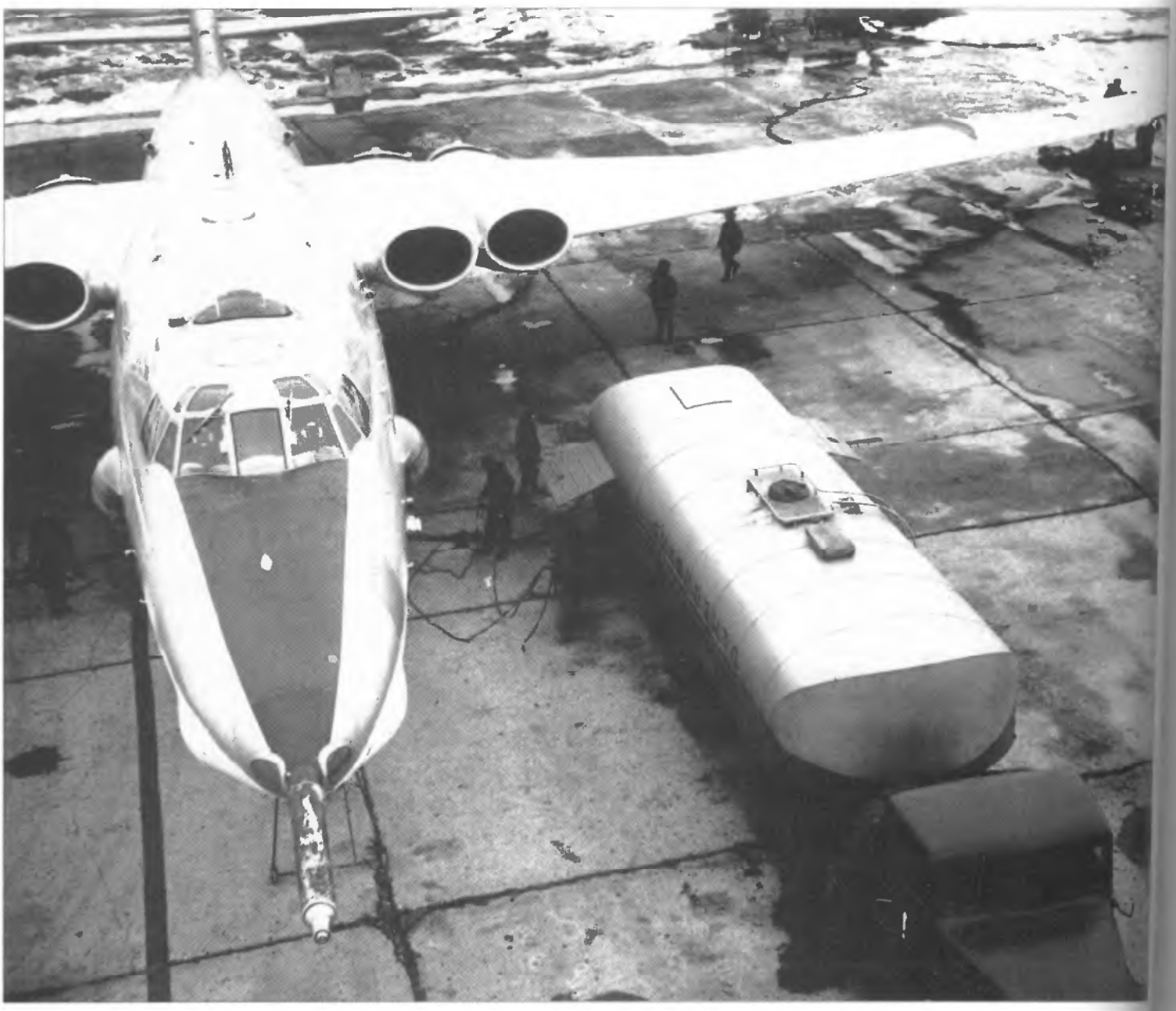
DA crews had some trouble mastering the probe and drogue IFR technique. As already mentioned in the previous chapter, the *Bison* tanker featured an HDU with a long hose terminating in a stabilising drogue with a locking mechanism. The receiver aircraft was equipped with a long probe tipped with a special adapter which locked into the drogue; to facilitate contact the drogue was telescopic and could be 'fired' pneumatically into the drogue. However, the apparently simple procedure turned out to be not that simple after all. Bomber crews returned to base without making contact, reporting at the debriefing that they had followed the prescribed 'approach, point and shoot' procedure but the probe simply would not lock up. Careful analysis of the missions, however, showed that the pilots had been over-cautious, 'firing' the probe at excessively long range. Small wonder it did not lock into place!

In the autumn of 1960 OKB-23 formally ceased to exist as a result of changing government policy towards aviation in general, becoming the Experimental Machinery Plant (EMZ – *Eksperimen**tahl'**nyy ma**shin**ostroi**tel'**nyy za**vod**). (The former OKB-23 is still referred to hereinafter as the Myasishchev OKB for the sake of convenience.) Yet its progeny continued flying and scaring the Soviet Union's 'potential adversaries'. The 3MSs and 3MNs flew long-range recce missions over international waters on a regular basis, shadowing NATO warships, and participated in all manner of military exercises right up to the 'ministerial' level (ie, those commanded by the Soviet Minister of Defence). To dupe the West into thinking the Soviet Air Force had more *Bisons* than it actually possessed, the two-digit tactical codes carried on the fin and the nose gear doors were changed from time to time. In reality, however, the VVS suffered badly from a lack of these heavy aircraft.

In 1962 the VVS inventory included 78 3M bombers and 25 M-4-2 tankers – ie, 103 of the 116 production *Bisons*. Most of these aircraft had by then been in service for more than six years, exceeding their service life limit of 1,000 hours. On 15th April 1962 Pyotr V.

Above: A typical Soviet-era publicity shot showing the crew of a 3MD conferring before a night-time sortie. The aircraft's tactical code ('47 Red') is painted on the access ladder to prevent it from being stolen.

A 9,000-kg (19,840-lb) bomb is wheeled towards a 3MD coded '25 Red' by a special bomb transporter/loader vehicle on a wintry airfield.



Another *Bison-C* is readied for flight. This 'bird's-eye' perspective shows well the 3MD's characteristic 'cheekbones'.

Dement'yev, Chairman of the State Committee for Aviation Hardware (GKAT – *Gosoo**darst**vennyy komi**tet** po a**viatsion**noy **tekh**nike*, as the former MAP was known in 1957-62), reported to the Communist Party Central Committee: *'...due to the Air Force's demands to ensure the operational safety of these aircraft up to 1970 it is advisable to perform certain design work and modifications aimed at keeping the 3M and M-4 aircraft up to current operational and tactical standards. To this end the KB-201 design bureau responsible for the 3M and M-4 aircraft has now been formed at the branch office of OKB-52. The plant named after Khrunichev* (ie, the former plant No. 23 in Fili – *Auth.*) *has been assigned responsibility for all manufacturing work associated with 3M and M-4 operations and conversion to refuelling tankers.'*

Starting in the summer of 1962, the surviving M-4s had their outer wings reinforced as a precaution against fatigue cracks (several cases of fatigue cracking had been discovered on operational aircraft). The design work was performed by a team of ten KB-201 employees under Deputy Chief Designer Yakov B. Nodel'man. (Consider that the new 'Bison Bureau' had a total of only 30 people on its payroll.) Obtaining an M-4 airframe, TsAGI held a new series of static tests, while SibNIA consecutively tested three *Bison-B* airframes at loads increasingly approaching the actual operational loads. Together with the VVS the engineers set up a system of monitoring the current condition of operational *Bisons*, detecting fatigue cracks as they appeared. The tests at TsAGI and SibNIA were backed by theoretical research which made it possible to pinpoint the places in the highly stressed airframe structure which were most prone to fatigue damage during lengthy operation; this allowed the *Bison*'s service life to be appreciably extended in the long ru
Later, Vladimir M. Myasishchev and his tea
were awarded honorary medals by th
VDNKh (***Vys**tavka dosti**zheni**y na-rodno
kho**ziay**stva* – National Economy Achiev
ments Exhibition) in Moscow in recognition
this research effort.

The notorious shootdown of Francis Ga
Powers' high-flying Lockheed U-2A spyplan
(56-6689) by an S-75 SAM (NATO code nam
SA-2 *Guideline*) near Sverdlovsk on 1st M
1960 had made it patently clear that strate
bombers were no longer invulnerable at hig
altitudes. The USA quickly devised an 'a
SAM tactic' – from 1962 onwards the B-
were to penetrate the enemy's SAM barri
at low altitude where the missile guidan
radars could not track them. The Soviet Un
responded in kind; in January-August 196
research programme was held to investig
the possibility of maximum-range flights

The
carri

Above: The bustle of activity around M-4-2 '72 Red' (c/n 5300710) is explained by the fact that the aircraft is being placed into storage – probably never to fly again. Note that it is parked on a grass field, with only a few concrete slabs under the nose and main gear to prevent it from sinking into the mud later.

The end of the road. This dismembered 3MN-1 shared the sad fate of nearly all *Bisons*, being scrapped in compliance with arms reduction treaties. This bomber carries the 'Excellent aircraft' badge on the fuselage rather than on the nose gear doors. Note the VD-7B engines lying beside the aircraft.

Tu-95 and 3M bombers at 50-200 m (164-660 ft) in the daytime when obstacles and terrain were visible and 200-300 m (660-980 ft) at night. This low-level penetration tactic significantly increased the chances of air defence penetration by single aircraft (formation flying was ruled out – for safety reasons, if nothing else). However, these low-level flights never got further than the experimental stage; operational use of this tactic required the aircraft (including the 3M) to be modified in order to withstand the turbulence at low altitude. MAP declined to undertake this work which eventually had to be performed by the Ministry of General Machinery (MOM – *Ministerstvo obschchevo mashinostroyeniya*), the agency responsible for the Soviet space and missile programmes. The Council of Ministers tasked V. N. Boogaiskiy, who headed Branch 1 of OKB-52, with getting the 3M low-level combat operations programme included into the task list of KB-90 headed by V. Goosarov; the work was to proceed in January-February 1966. The bomber's range on a 'hi-lo-hi' mission profile decreased dramatically, but this was an acceptable price for the reduced vulnerability during air defence penetration.

By the late 1960s new versions of the Tu-95 had taken over the 3M's role as a strike aircraft. By the early 1980s nearly all surviving *Bisons* had been converted into tankers, making up the backbone of the Soviet Air Force's tanker element until the advent of the Il'yushin IL-78 *Midas*. The conversions were irreversible in this case; the IFR probes were removed and the bomb bay partially faired over, leaving only small clamshell doors for the HDU.

Gradually the *Bison* was displaced by newer types. Sometimes, however, the trend was reversed. For instance, during the Afghan War the DA was tasked with suppressing the resistance of the Mujahideen rebels with conventional bombs to pave the way for Soviet troops. The 3Ms of the 1096th and 1230th TBAPs based at Engels-2 AB were also prepared for the mission along with other types; the tankers had to be temporarily reconverted by replacing the HDUs with cassette racks for 52 FAB-250s or 28 FAB-500s.

The Dobrynin-powered versions were phased out in the 1980s and prepared for scrapping in the early 1990s, though a few aircraft were placed in flyable storage. The remaining 3MS-2 tankers powered by low-time RD-3M-500As were combined in a single regiment. After the break-up of the Soviet Union the Russian Air Force was left with just 20 modern IL-78/IL-78M tankers, which meant the 3MS-2 could not be retired just yet. Still, the *Bison*'s days were numbered, as the Soviet Union had pledged to scrap a substantial number of these bombers under the SALT 2 arms reduction treaty – even though the VVS had much fewer heavy bombers than the USAF. The heart-rending pictures of 3Ms on the scrap heap have gained worldwide circulation.

The last crash of a *Bison* occurred on 16th May 1992 when two 3MS-2 tankers (one was '90 Red', c/n 7300505) collided in mid-air near Saratov en route from Engels to Semipalatinsk. Both aircraft exploded; only two of the 14 people aboard the two jets survived.

The last 3Ms soldiered on until mid-1994 when the units at Engels had mastered the state-of-the art Tu-160 *Blackjack* swing-wing supersonic bomber. The final sortie took place on 23rd March 1994; in August 1997 the remaining aircraft were ferried to a designated base for disposal.

Two *Bisons* survive in Russia. 3MS-2 '60 Red' (c/n 6302831) is preserved in the DA Museum at Dyagilevo AB, Ryazan', while 3MD '30 Red' (c/n 0301804) resides in the Central Russian Air Force Museum in Monino south of Moscow.

Myasishchev M-4 and 3M fleet details

C/n	Serial/code/reg'n	Version	Operator (unit)	Notes
2300001	none	M-4	Myasishchev OKB	First prototype; later serialled '25 Red'
2300002	none	M-4		Static test airframe
4300003	none	M-4	Myasishchev OKB	Second prototype; later coded, see next line
	'101 Red'	M-4	Myasishchev OKB	Torpedo-bomber
4300104	none	M-4	Myasishchev OKB	Later serialled '85 Red'; equipped with IFR probe
4300205	none	M-4	Myasishchev OKB	Converted to, see next line
	'71 Red'	M-4-2	Myasishchev OKB	First tanker prototype
4300306	'65 Red'	M-4		Converted to, see next line
		M-4-2	1230th APSZ, Engels-2 AB	
5300407	'10 Red'	M-4		Converted/recoded to, see next line
	'64 Red'	M-4-2	1230th APSZ, Engels-2 AB	
5300508	'62 Red'	M-4-2		Converted to, see next line
		M-4-2	1230th APSZ, Engels-2 AB	
5300609	not known	M-4		Crashed near Zhukovskiy 21-3-55
5300710	'72 Red'	M-4		
5300811	not known	M-4		
5300912	not known	M-4		Crashed 26-6-56
5301013	not known	M-4		Crashed 16-6-55 after in-flight fire
5301114	'24 Red'	M-4	Myasishchev OKB	
5301215	not known	M-4		
5301316	not known	M-4		
5301417	not known	M-4		Crashed 25-8-55
5301518	'63 Red'	M-4	Myasishchev OKB	Probe-equipped; IFR probe later removed
5301619	not known	M-4	Myasishchev OKB	Converted to, see next line
		M-4-2		Second tanker prototype
5301720	not known	M-4		
5301821	not known	M-4		
5301922	not known	M-4		
5302023	not known	M-4		Crashed near Omsk 23-8-57

C/n	Serial/code/reg'n	Version	Operator (unit)	Notes
5302124	'77 Red'	M-4-2	1230th APSZ, Engels-2 AB	
5302225	not known	M-4		
5302326	not known	M-4		
5302427	not known	M-4		
5302528	'03 Red'	M-4		Converted/recoded to, see next line
	'66 Red'	M-4-2	1230th APSZ, Engels-2 AB	
*302629	not known	M-4		
*302730	not known	M-4		
6302831	'01 Red'	M-4		Later recoded '55 Red'. Converted/recoded to, see next line
	'60 Red'	M-4-2	1230th APSZ, Engels-2 AB	Preserved DA Museum, Dyagilevo AB, Ryazan'
6302932	'24 Red'?	M-4-2	1230th APSZ, Engels-2 AB	Tactical code off poor-quality photo
6303033	not known	M-4		
6303134	'61 Red'	M-4-2	1230th APSZ, Engels-2 AB	
6303235	not known	M-4		Crashed 13-3-58 (some sources say 18-3-58)
5320101	none	3M	Myasishchev OKB	Later coded '60 Blue'
*3-0102		3M		
*3-0103	none	3M	Myasishchev OKB	Static test airframe?
*3-0104	not known	3M		AM-3A engines
*3-0105	not known	3M		
63-0201	not known	3M	Myasishchev OKB	VD-7 engines
63-0202	not known	3M		
63-0203	not known	3M		
63-0204	not known	3M		
63-0205	not known	3M		
6320301	'51 Red'	3MN-1	Myasishchev OKB	First aircraft with VD-7B engines
63-0302	not known	3M		
63-0303	not known	3M		Crashed 22-11-57
6300304	'23 Red'	3MS-2	1230th APSZ, Engels-2 AB	
63-0305	not known	3M		
6320401	'80 Red'	3M		Possibly coded '34 Red' earlier
*3-0402	not known	3M		
*3-0403	not known	3M		
*3-0404	not known	3M		
7300405	'26 Red'	3MS-2	1230th APSZ, Engels-2 AB	
7300501	'83 Red'	3MS-2	1230th APSZ, Engels-2 AB	
7300502	'17 Red'	3M	Myasishchev OKB	
7300503	not known	3MN-1		Converted to, see next line
		3M-5	Myasishchev OKB	
7300504	not known	3M		
7300505	'90 Red'	3MS-2	1230th APSZ, Engels-2 AB	Collided with another 3MS-2 and crashed near Saratov 16-5-92
7300601	'24 Red'	3MS-2		Later recoded '21 Red'
7300602	'22 Red'	3M		
7300603	not known	3M		
7300604	'27 Red'	3MS-2	1230th APSZ, Engels-2 AB	
7300605	not known	3M		
7300701	not known	3M		
7300702	not known	3M		
7300703	not known	3M		
7300704	not known	3M		Damaged by fire Akhtoobinsk AB 14-2-58
7300705	not known	3M		
6320801	'63 Red'	3M		Year in c/n out of sequence. Converted/recoded to, see next line
	'24 Red'	3MS-2	1230th APSZ, Engels-2 AB	
7300802	'25 Red'	3M		
7300805	'14 Red'	3MS-2	1230th APSZ, Engels-2 AB	
*300901	not known	3M		First production 3MS with RD-3M-500A engines. Destroyed by fire 20-9-58
*3004-2	not known	3M		
*3004-6	not known	3M		
*3004-4	not known	3M		
*300905	not known	3M		
6301001	not known	3M		
6301002	not known	3M		
6301003	not known	3M		
6301004	not known	3M		

C/n	Serial/code/reg'n	Version	Operator (unit)	Notes
8301005	not known	3M		
8301101	none	3MN-1		Converted 3-59 to, see next line
	none	3ME	Myasishchev OKB	DBR Zhukovskiy 12-5-60
*301102	not known	3M		
*301103	not known	3M		
*301104	not known	3M		
*301105	not known	3M		
*301201	not known	3M		
*301202	not known	3M		
*301203	not known	3M		
*301204	not known	3M		
*301205	not known	3M		
9301301	not known	3MD	Myasishchev OKB	First prototype, manufactured 11-59
9301302	not known	3MD	Myasishchev OKB	Second prototype, manufactured 1960
9301303	not known	3M		
9301304	not known	3M		
9301305	not known	3M		
9301402	not known	3MN-2	1230th APSZ, Engels-2 AB	Converted/registered as, see next line
	CCCP-01402	VM-T	Myasishchev OKB	First flew 29-4-81
9301403	not known	3M		
9301404	not known	3M		
9301405	not known	3M		
9301501	not known	3MS-1		
9301502	not known	3MN-2	1230th APSZ, Engels-2 AB	Converted/registered as, see next line
	CCCP-01502	VM-T	Myasishchev OKB	Delivered 25-1-82, first flew 3-82; reregistered RF-01502 by 8-93
9301503	not known	3M		
9301504	not known	3MN-2	1230th APSZ, Engels-2 AB	Converted to, see next line
	none	VM-T	Myasishchev OKB	Static test airframe; to TsAGI and SibNIA for destructive testing
*301505	not known	3M		
*301601	not known	3M		
*301602	not known	3M		
*301603	not known	3M		
*301604	not known	3M		
*301605	not known	3M		
0301701	not known	3MS		Last production 3MS
0301702	not known	3MD		First production 3MD
0301703	not known	3MD		
0301704	not known	3MD		
0301705	not known	3MD		
0301801	not known	3MD		
0301802	not known	3MD		
0301803	not known	3MD		
0301804	'30 Red'	3MD		Preserved Central Russian Air Force Museum, Monino
0301805	not known	3MD		Last production 3MD

World records held by the M-4 and 3M

Record	Aircraft	Date	Crew
Altitude 15,313 m (50,239 ft) with 5- and 10-ton (11,020 and 22,045-lb) payloads	'103M' (M-4)	16-10-59	N. I. Goryainov, A. S. Lipko, A. S. Iksanov, V. S. Koozovlev, S. A. Sokolov, V. V. Kolosov
Altitude 13,121 m (43,048 ft) with 5, 10, 15, 20, 30, 35, 40, 45, 50 and 55-ton (11,020, 22,045, 33,070, 44,090, 66,140, 77,160, 88,180, 99,200, 110,230, and 121,250-lb) payloads	'201M' (3M)	29-10-59	B. M. Stepanov, B. I. Yumashev, V. I. Sevost'yanov, I. I. Rykhlov, V. S. Koozovlev, A. P. Okhtyrkov, A. S. Iksanov
Average speed 1,028 km/h (638.5 mph) over a 1,000-km (621-mile) closed circuit	'103M' (M-4)	30-10-59	A. S. Lipko, B. I. Yumashev, V. I. Milyutin, L. N. Goosev, I. M. Korchagin, A. A. Moshin, V. V. Kolosov, V. P. Glooshkov

Chapter 6

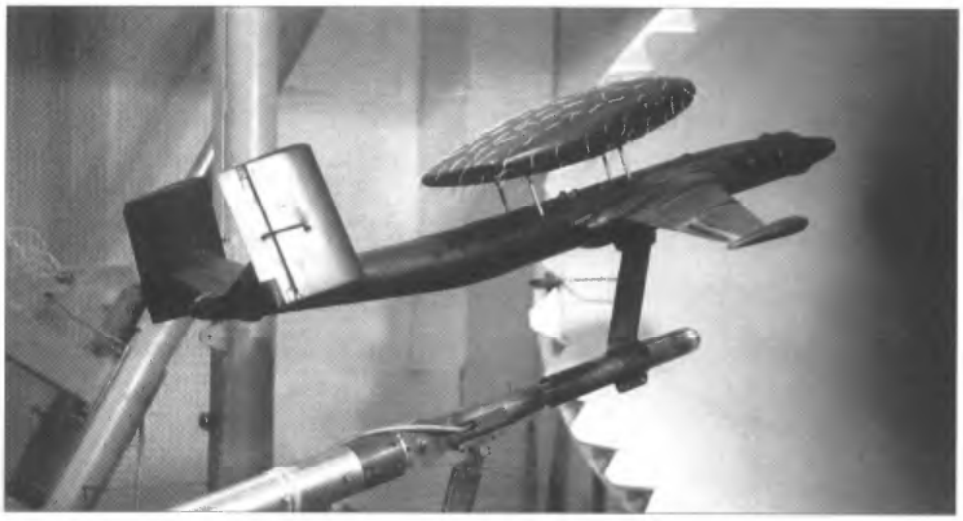
The Bomber Goes Civil

3M-T (VM-T Atlant) outsize cargo carrier

In the mid-1970s the USA began accelerated development of a reusable space transport system that soon became universally known as the Space Shuttle. The Soviet Union responded by launching development of a similar system; officially named Baikal after the world's deepest lake located in East Siberia, it was known to the general public the world over under the name Buran (Snowstorm). Communist Party Central Committee/Council of Ministers joint directive No. 132-51 dated 17th February 1976, backed by MAP orders No. 81 of 24th February and No. 106 of 15th March, assigned NPO Energiya ('Energy' Scientific & Production Association) as the 'prime contractor' for the programme. NPO Energiya was to create an ultra-heavy multi-purpose rocket space transport system of the same name, the likes of which had not been seen before. The core of the system was a huge space launch vehicle (SLV) designed for placing large satellites, manned space station modules and space shuttles into orbit.

The directive assigned NPO Molniya (Lightning) as the main designer of the Soviet shuttle orbiter, with Myasishchev's Experimental Machinery Plant as co-designer. The latter clause was no coincidence; the OKB already had some experience with space vehicles, having developed the M-19 aerospaceplane in 1974-75 (which in the event never materialised – but that's another story). This valuable experience would now be put to good use.

At the technical proposal stage both enterprises vied for the government order for the shuttle, NPO Molniya's project being designated *izdeliye* 305-1 while the Myasishchev OKB developed *izdeliye* 305-2. At the same time the Ministry of General Machinery (MOM – *Ministerstvo obschchevo mashinostroyeniya*) responsible for the Soviet space and missile programmes placed an order with MAP for the development of an airlift system – to be precise, the airlift component of the reusable space transport system that would deliver SLV modules and the shuttle orbiter to the launch pad. Transporting these items by road or river/sea was impracticable – not so much due to their bulk (or to security restrictions) but first and foremost because the cargo would be subjected to prolonged vibrations and rocking during the journey, which could ruin the huge rocket. The airlift system comprised a special transport aircraft, loading equipment and ground support equipment.



Above: A model of the 3M-T (VM-T) in Myasishchev's T-1 wind tunnel. The flattened disc-like pod was proposed for transporting the French Hermes shuttle orbiter; note the wool tufts for flow visualisation.

This large-scale partial model of the 3M-T in the TsAGI T-104 wind tunnel is fitted with a model of 'payload 2GT' (the lower section and nose fairing of the Energiya SLV). Note the payload attachment points.

MAP tasked the Kiev-based OKB-473 headed by Oleg Konstantinovich Antonov with developing the airlift system. By then design work on the *izdeliye* 400 heavy military transport aircraft – the future An-124 Ruslan (NATO reporting name *Condor*) – was well advanced. This aircraft looked set to be the OKB's 'bread and butter' for many years to come, so Antonov took the decision that the airlift system should be designed around the An-124 – disregarding the fact that, large as the Ruslan's freight hold was, it was not large enough to accommodate the components of the Energiya SLV. MOM repeatedly called attention to this fact, eventually pressuring the Antonov OKB into developing a tailor-made 'rocket transporter' aircraft – the mighty six-engined, twin-tailed An-225 Mriya ('Dream' in

Above: The first flying example of the VM-T (c/n 9301402) nearing completion in the Myasishchev OKB's experimental shop, with the fuselage of the static test article (c/n 9301504) in the background

Ukrainian; NATO reporting name *Cossack*) derived from the An-124. The twin vertical tails assured the Mriya adequate directional stability when carrying bulky rocket components on top of the fuselage.

However, much time was wasted in cajoling Antonov. The prototypes of the Energiya SLV and the Baikal/Buran orbiter were nearing completion in the meantime; soon they would have to be transported from Moscow to the Baikonur Space Centre in Kazakhstan for final assembly and testing. Therefore the Myasishchev OKB's bold proposal to adapt the 3M bomber for this mission came at just the right moment. The idea was not so wild as it may seem: the 3M could cope with the envisaged loads. Nor was this the most exotic proposal; other ideas under consideration involved the use of An-22 Antey (Antheus; NATO reporting name *Cock*) and Il'yushin IL-76 *Candid* transports as carrier aircraft long-line operations with a pair of Mil' Mi-26 *Halo* heavy-lift helicopters (the method was used occasionally when erecting power-line pylons) and even the use of airships!

Actually, the Myasishchev OKB considered using the 3M bomber as a shuttle carrier even as the technical proposal for the *izdeliye* 305-2 orbiter was drawn up. Several wind tunnel models representing an otherwise standard 3M with auxiliary endplate fins on the stabilisers and the space shuttle riding piggy-back were manufactured and tested. When the shuttle was fitted with a tail fairing covering the rocket motor nozzles for a ferry flight the bomber's normal vertical tail would be removed to avoid buffeting, leaving the aircraft with a twin-tail empennage.

It was envisaged that the shuttle carrier would retain the baseline bomber's IFR capability, which would obviate the need for in-flight refuelling stops en route. The engineers considered the possibility of free-flight tests in which the *izdeliye* 305-2 orbiter would be taken aloft by the 3M shuttle carrier, gliding to earth after separation. The experiments and calculations performed by the Myasishchev OKB confirmed the feasibility of such a conversion.

Nevertheless there were considerable risks involved. The idea of using the 3M as a shuttle carrier sparked bitter opposition com-

The crew of VM-T CCCP-01402 poses after the maiden flight on 29th April 1981. Left to right: I. Semookhin, V. Padookov, N. Gheneralov, A. Kucherenko, S. Sokolov, B. Ayzatoolin

from the bosses of NPO Molniya (which Myasishchev's Experimental Machinery Plant was part of at the time) and the scientific leaders of LII and TsAGI. Academicians Gheorgiy Sergeyevich Büschgens and Gheorgiy Petrovich Svischchev called on Myasishchev, urging the General Designer to give up this 'crazy idea'. Nevertheless, Vladimir M. Myasishchev stuck to his decision.

Interestingly, Myasishchev himself was against the idea at first. One by one he summoned and sternly questioned aerodynamicist A. A. Brook, project engineer V. V. Lyubakov who was responsible for the general arrangement, structural strength engineer A. Kh. Karimov, control system engineers, electrics engineers, operations department specialists and economists. All of them unanimously spoke in support of the project, stating that the idea was feasible and should indeed be proceeded with. Myasishchev thanked each interviewee in a restrained manner and let him go.

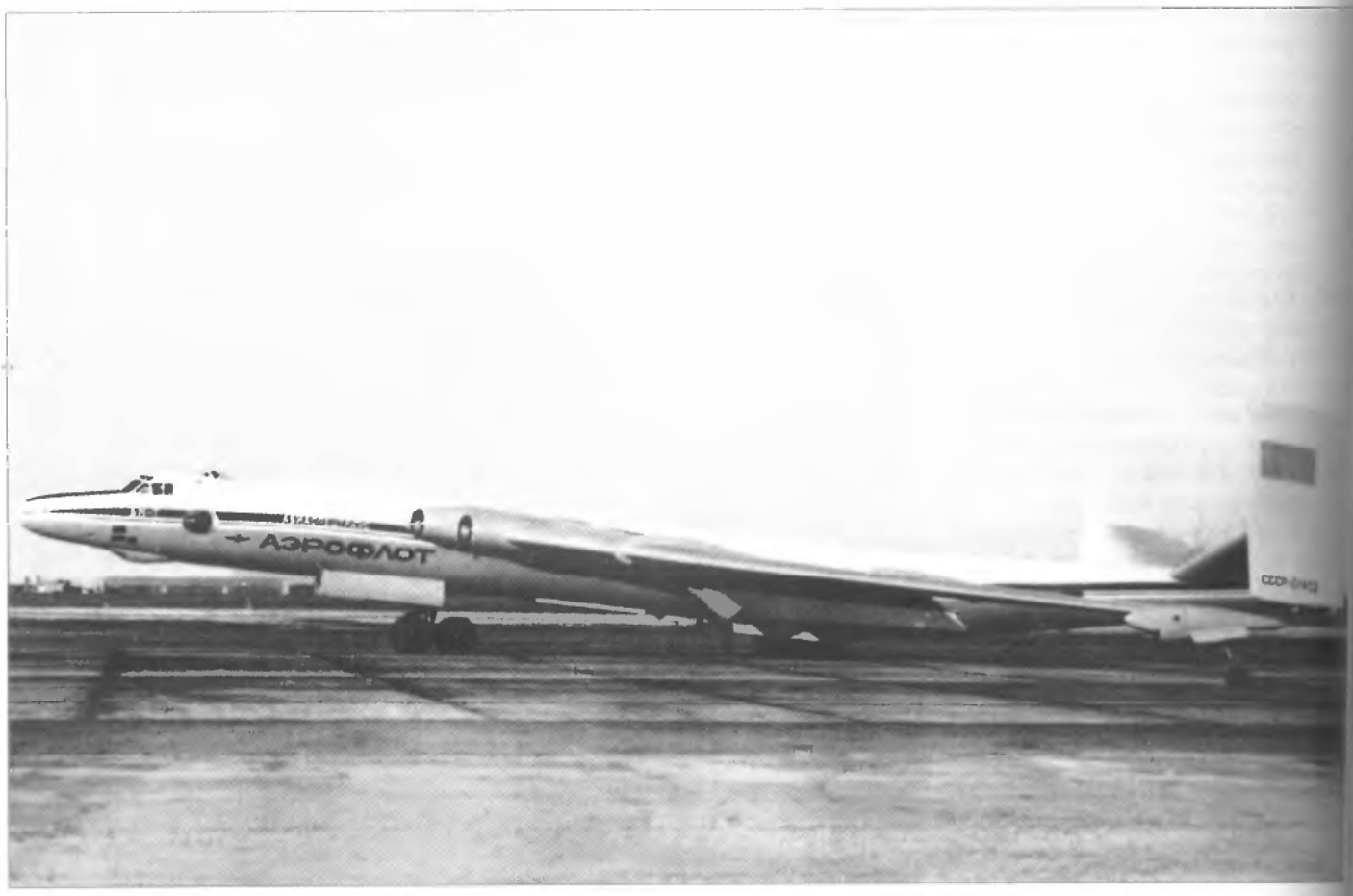
As already mentioned, a number of models were tested in TsAGI's various wind tunnels to prove the possibility of using the 3M as a shuttle carrier. The Myasishchev OKB's aerodynamics department further insisted that a 1/4th-scale model of the aircraft with various payload configurations be tested in TsAGI's oldest and largest wind tunnel – the T-101 built in the 1930s and used for testing full-scale fighter airframes during the Great Patriotic War. Many questioned the advisability of manufacturing such an expensive model; it was only the support of V. G. Mikeladze, the then Director of TsAGI's Section 2, that tipped the scales in favour of these tests. It was worth the effort: the test results eliminated the irregularities experienced in the smaller wind tunnels, allowing the aircraft's control system to be kept simple.

Another major success achieved by the Myasishchev OKB was the resolution of the aerodynamic interference problems associated with carrying huge external loads. Of course, this work could not have been performed without close cooperation with TsAGI. When the placement of all cargoes envisaged by the project had been tested in wind tunnels and by mathematical analysis (in a remarkably short period of time, it should be noted), the OKB was able to select the optimum parameters for each payload configuration.

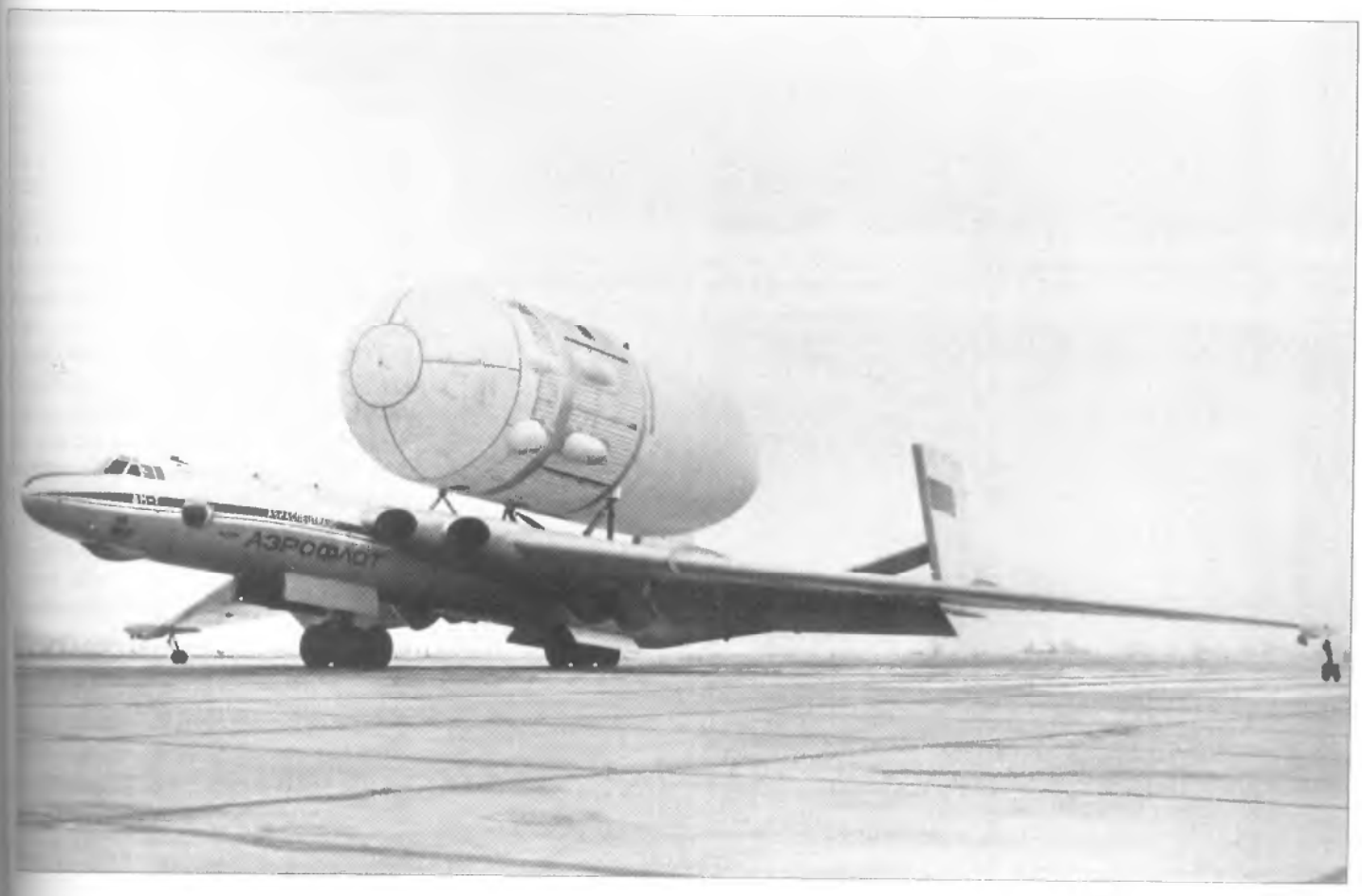
Development of a specialised cargo aircraft for hauling outsize loads to Baikonur was officially started by Communist Party Central Committee/Council of Ministers joint directive No. 1006-323 dated 21st November 1977 and MAP order No. 512 dated 30th December 1977. The aircraft was referred to in these documents as *izdeliye* 3-35; in the Myasishchev OKB, however, it was designated VM-T. The designation had been used earlier

These three photos of VM-T CCCP-01402 (c/n 9301402) on final approach to Zhukovskiy in no-load configuration during trials illustrate the aircraft's dachshund-like fuselage. Note the ventral ADF strake aerials with Doppler speed/drift sensor array between them. The refuelling probe is clearly visible.

Above and below: These were the first publicity shots of the VM-T, taken in the days when CCCP-01402 still lacked IFR capability. The titles superimposed on the cheatline read 'Aviaspetstrans'. The extreme dihedral of the stabilisers and the large size of the not-exactly-vertical tails are well illustrated in these views.

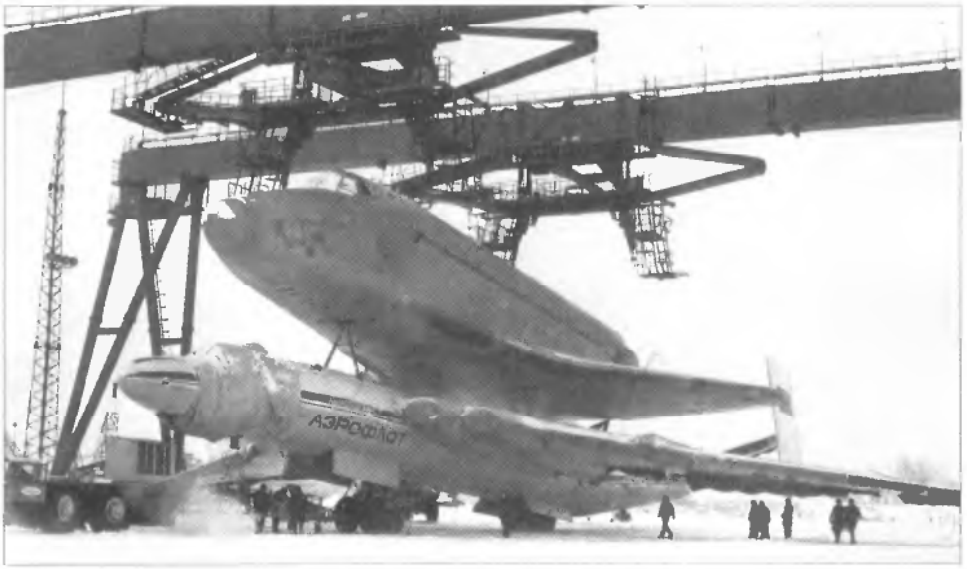


Above: 'The egg that hatched Buran.' Here CCCP-01402 is shown with 'payload 3GT' (the nose and tail transport fairings of the Energiya's fuel tank joined together).
Below: The VM-T with 'payload 2GT'; the fluted texture of the cylindrical lower section of the Energiya SLV is noteworthy.



Above: Placing the cargo (in this case a dummy 'payload 2GT') on the aircraft's back required strength and precision – and the PKU-50.01 gantry crane had both. The VM-T is dwarfed by the huge structure.

Above: The VM-T made its public debut on 20th August 1989 when CCCP-01502 took part in the annual Aviation Day flypast at Moscow-Tushino. The blocks of flats in the background show well how low it passed.



The third Buran shuttle orbiter (*izdeliye* 11F35 c/n 0.03) shortly after loading on a VM-T. The vertical tail has been removed to give the combination adequate stability. Note the tarpaulin over the transport's flightdeck.

for a projected tanker version of the 3MD bomber; in this case, however, the T stood for ***trahns**portnyy* [*samo**lyot***] – transport aircraft. This high level of the authorising document speaks for itself: the shuttle carrier was included into the national space programme, ergo ultra-important.

Boris I. Zorin was appointed chief project engineer; after his death in harness V. A. Korchagin became the 3M-T's project chief, assisted by project engineer V. M. Kirillin. The Myasishchev OKB's involvement in the multi-purpose rocket space transport system programme as a 'subcontractor' stretched its resources to the limit, requiring a substantial reinforcement of the design staff. Several experienced engineers were hired, along with numerous graduates of MAI and the Kuibyshev Aviation Institute. Additionally, the OKB's experimental shop and flight test facility in Zhukovskiy had to be thoroughly reorganised and re-equipped with the latest hardware; new ground test rigs were constructed and co-operation ties established with numerous enterprises within the MAP and MOM frameworks.

The promising results yielded by the wind tunnel tests and mathematical analysis under the *izdeliye* 3-35 programme triggered the development of numerous transport systems designed for airlifting outsize loads. This was prompted by the fact that TsAGI together with the State Institute of Transport Problems (a division of Gosplan – the Ministry of State Planning) had by then accumulated a wealth of statistical data on where and how such loads were transported.

Of course, the Myasishchev OKB took due notice of what Western companies were doing in this field. Starting in the early 1960s US specialists had developed six outsize cargo carrier aircraft based on heavily modified Boeing C-97 transports and bearing the common name Guppy (Pregnant Guppy, Very Pregnant Guppy, Super Guppy, etc.). The last of the line was the Colossal Guppy which had an upper fuselage lobe diameter of 12.2 m (40 ft) and a 90-ton (198,400-lb) payload. However, it should be noted that, like their Soviet colleagues, American aeronautical engineers also considered external carriage of bulky items by heavy transport aircraft. For instance, the Lockheed Company tried to adapt the C-5A Galaxy military transport for carrying SLV stages in a special container atop the fuselage under a NASA contract – an idea which eventually came to nothing. The Boeing Commercial Aircraft Group was more fortunate, converting an ex-American Airlines Boeing 747-123 into the Boeing 747SCA (Shuttle Carrier Aircraft) for NASA; this aircraft was used for free-flight gliding tests of the Space Shuttle prototype *Enterprise*. Moreover, in spite of the huge

costs involved, NASA commissioned development of several highly unorthodox aircraft tailored for carrying rocket system components externally (the Virtus, Twin Body, etc.); none of them materialised. Other exotic ideas floated in the USA included using a C-5A to tow the Space Shuttle like a glider and a Lockheed C-130 Hercules transport for towing a huge glider beneath which an aerospaceplane was suspended! (Obviously the space vehicle would have been of a different type and much smaller size in the latter case.)

In the case of the 3M-T the loaded aircraft was a preposterous sight, as the fuel tank/main module of the Energiya SLV was 2.3 times larger in diameter than the bomber's fuselage and nearly as long as the aircraft itself! (To be precise, its length made up more than 80% of the fuselage length – including the stretch incorporated in the process of conversion for the transport role!) Nevertheless, after receiving the go-ahead from the scientists the engineers set to work.

It would not be doing the Myasishchev OKB justice to say that the shuttle carrier was merely an adaptation of the *Bison* for a new role; the changes were so extensive that the result was, in effect, a new aircraft. Like their colleagues in the Antonov OKB, the engineers developed a twin-fin tail unit for the 3M-T. However, the new tail unit generated much higher structural loads; hence the airframe had to be reinforced and the rear fuselage redesigned completely. The tail unit area amounted to 26% of the wing area; making it any smaller was impossible because the powerful vortices generated by the bulky external load would cause tailplane buffet – a highly dangerous phenomenon which might result in structural failure. The fins were of simple rectangular shape and the unswept stabilisers featured marked dihedral. Sweep was not necessary, since cruising speed with an external load would not exceed 450 km/h (280 mph), while the strong dihedral reduced the torsional loads generated by the tail unit. Also, the larger area of the stabilisers compared with the 3M increased the lift and hence the pitch-down force generated by them, compensating for the pitch-up force created by the dorsally-mounted load.

The new rear fuselage was 7 m (22 ft 11½ in) longer and was upswept to provide adequate ground clearance – a necessity due to the aircraft's characteristic nose-high ground angle. The bomb bay was faired over, the new skin panel absorbing part of the structural loads; this panel incorporated a small hatch for access to the equipment housed in the bay. The dorsal and ventral cannon barbettes were also deleted, of course.

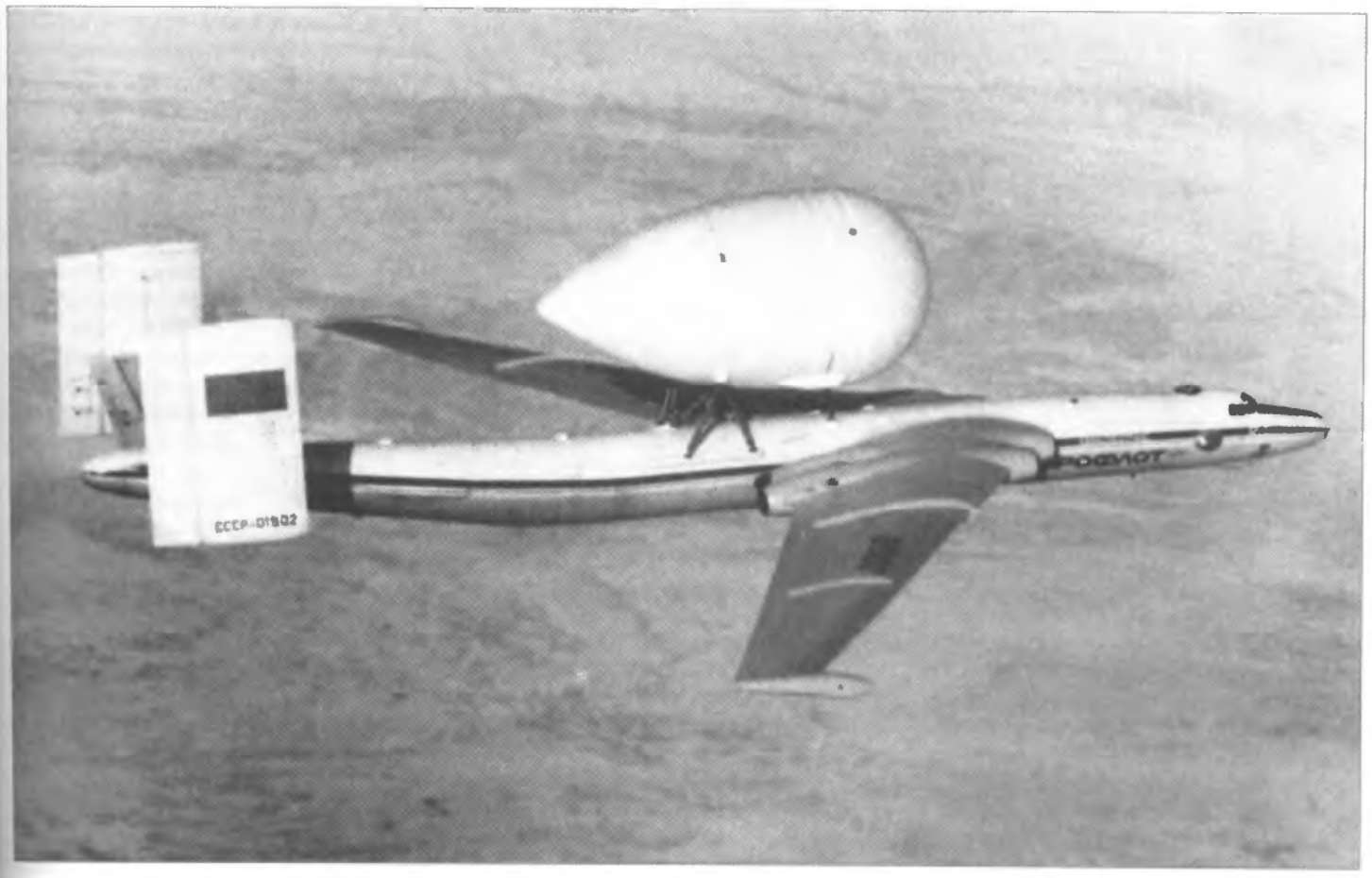
The nose and main landing gear units were stock 3M items, but the wingtip outrigger struts had to be reinforced because of the

Above: By 1991 VM-T CCCP-01502 (c/n 9301502), which was used for demonstration flights with a dummy 'payload 1GT', had become a 'flying billboard', advertising for the ASKO joint-stock Insurance company.

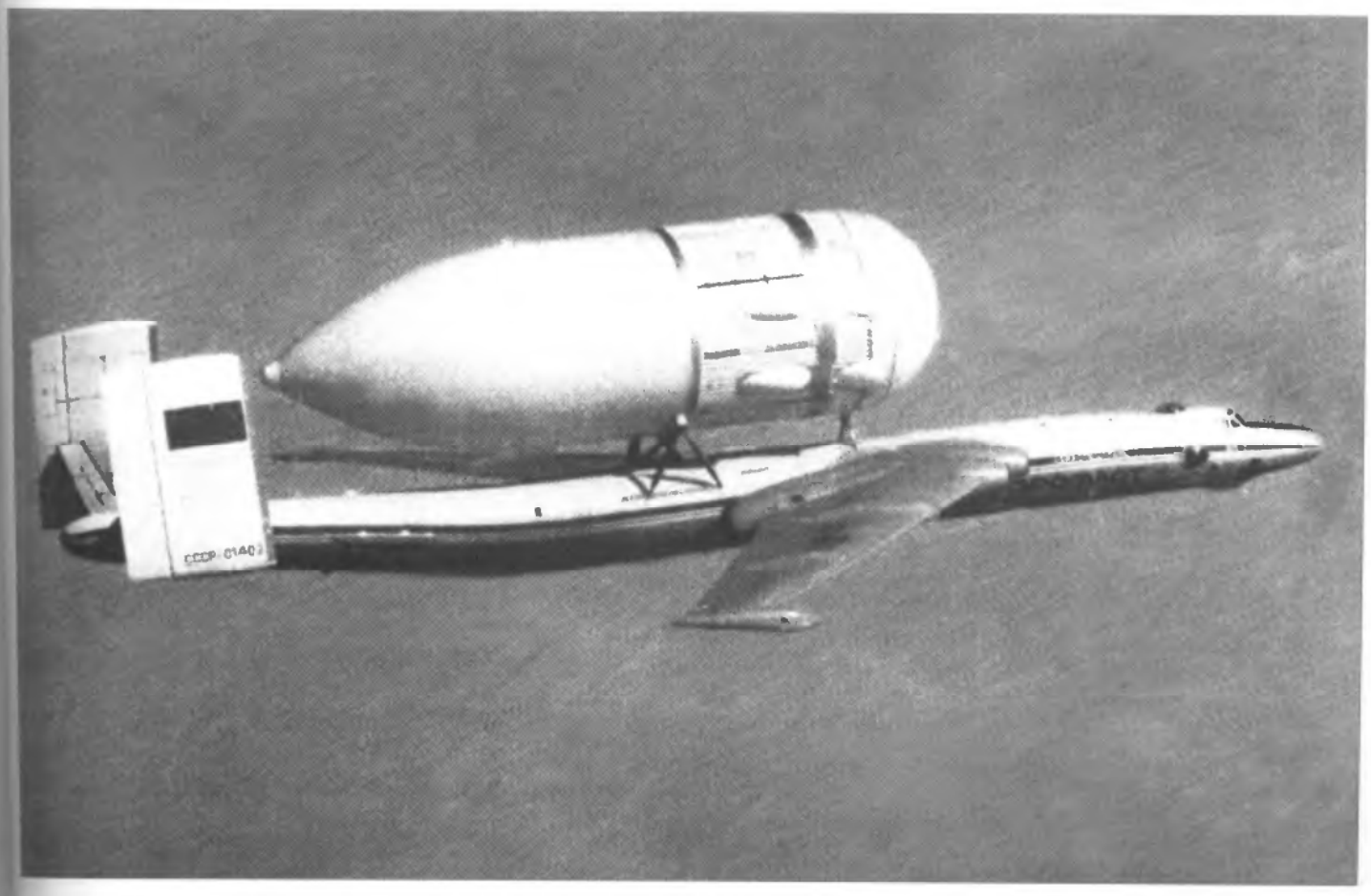
Above: CCCP-01502 tucks its undercarriage up as it makes a typically smokey take-off carrying 'The Great Plywood Rocket' (devoid of markings in this instance).

This photo taken at Zhukovskiy shows how the two halves of the PKU-50.01 crane could be slid apart to suit different payload lengths.

Above and below: These two views of the VM-T with a dummy 'payload 1GT' illustrate clearly that the payload was more than twice the fuselage diameter and nearly as long as the aircraft itself. Small wonder some people were opposed to the idea of the VM-T flying with cargoes! Fortunately the sceptics were wrong.



Above: VM-T CCCP-01502 with 'return payload 3GT' in flight. This was the draggiest of all the VM-T's payloads, creating a powerful vortex wake.
Below: The as-yet probeless CCCP-01402 with 'payload 2GT'. Note the two pairs of faired attachment points for the payload retention struts.



Above: The first VM-T on the Myasishchev apron at Zhukovskly in the early 1990s.

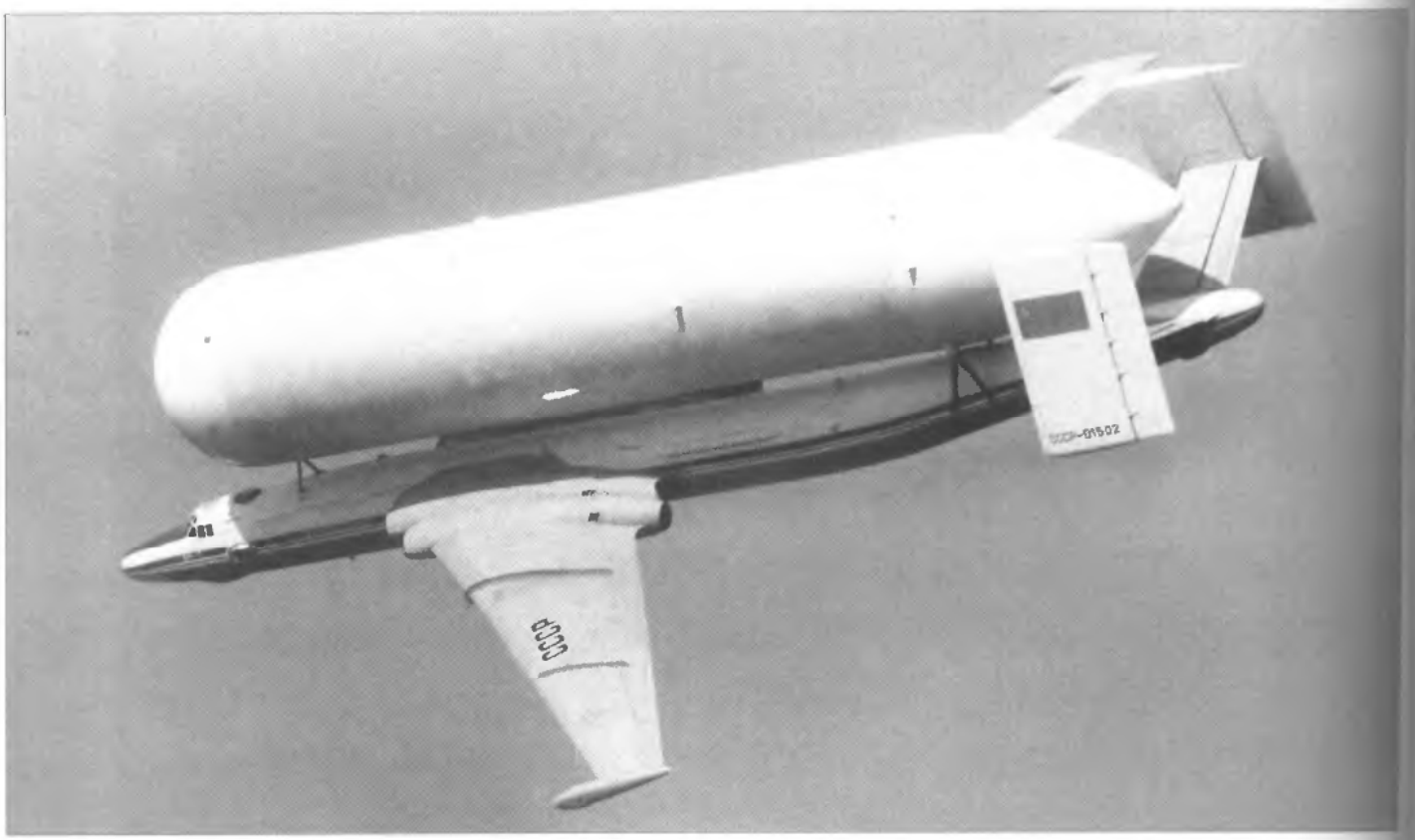
greater loads absorbed in the event of a banked landing in a crosswind. The flight control system was all-new, featuring an automatic stability enhancement system; irreversible hydraulic actuators were used in all three control circuits instead of reversible ones. This assured flight safety and adequate stability and handling throughout the flight envelope in both no-load and loaded configuration.

The fuel system was modified, allowing fuel to be transferred in order to change the CG position according to the weight of the cargo carried. The aircraft was re-engined with more powerful Dobrynin VD-7MD non-afterburning turbojets rated at 10,750 kgp (23,700 lb st) for take-off.

The cargo was secured by a system of struts forming three-dimensional trusses located in pairs on the forward and rear fuselage. Each strut was adjustable lengthwise and featured joints at both ends to alleviate bending loads. To allow for possible errors in anchoring point placement on the cargo, two of the struts making up the starboard rear truss incorporated spring-loaded length compensators, making it possible to attach the cargo without levelling the aircraft properly. The crew was reduced to six, the dorsal and tail gunners being unnecessary on a transport aircraft.

If developing the 3M-T was a complex task, developing the associated cargo handling equipment was no easy matter either. Designated PKU-50.01 (*po**groo**zochno-kozlo**voy**e oo**stroy**stvo*), the colossal gantry crane was to load and offload the components of the Energiya/Baikal space transport system, the heaviest of which weighed 32 tons (70,550 lb). The accuracy margin was to be no more than a few millimetres and the crane was to operate in wind speeds up to 15 m/sec (30 kts). This huge machine was designed and built in-house (actually two such cranes were built – one in Zhukovsky and one at Yubileynyy airfield in Leninsk, Kazakhstan, near Baikonur); it was more than 50 m (164 ft) long, 60 m (196 ft 10 in) wide and 20 m (65 ft 7 in) high. The PKU-50.01 made it possible to handle items weighing up to 50 tons (110,230 lb) – and handle them gently.

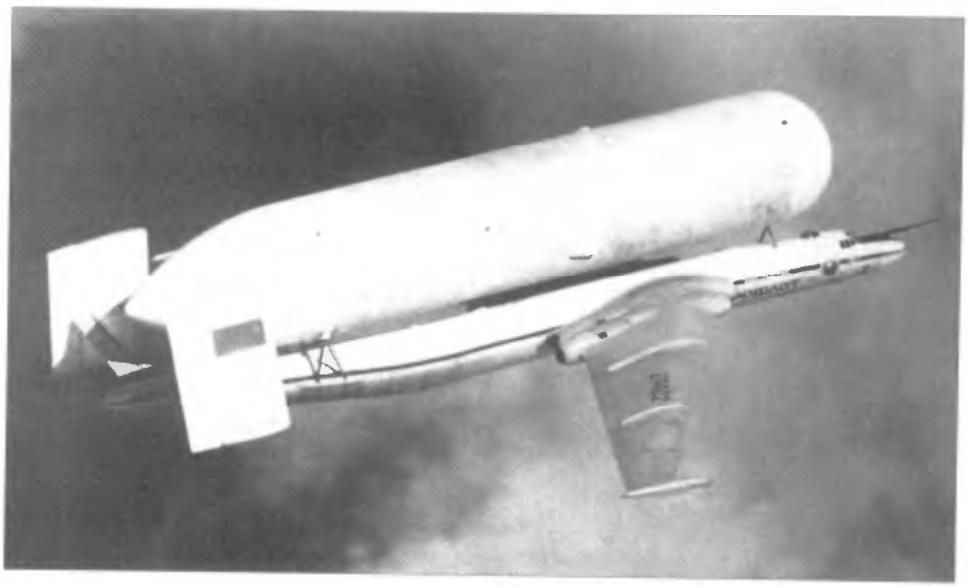
The advanced development project of the VM-T was submitted in mid-1978 and approved by the industry's R&D establishments and the customer; the OKB started issuing manufacturing drawings and preparing to convert...



Even with a huge payload like Energiya's fuel tank, the VM-T displayed surprising agility, as demonstrated by this tight turn during an airshow performance. The upward curvature of the aft fuselage is clearly visible.

To convert *what*? Good question. Obtaining the required three aircraft for conversion proved to be a major problem. The help of the then Director of the Cosmonaut Training Centre, Distinguished Military Pilot Maj. Gen. Nikolay F. Kuznetsov, Dr. Mil. Sc., proved pivotal in this matter. By the greatest good luck he and DA Commander Col. Gen. Vasiliy V. Reshetnikov were buddies, having served in the same Air Force unit during the Great Patriotic War. After arranging a meeting with Reshetnikov, whom he had not seen for a long time, Kuznetsov arrived not alone but with Myasishchev OKB representatives in tow. The two veterans gave each other a great bear hug and started recalling days gone by. A while later, when everyone was in a good mood, the OKB's spokesman stated his case, summing up with the request to transfer three bombers to the Experimental Machinery Plant. Reshetnikov, whose assent was all-important, was less than enthusiastic, to say the least. 'Are you kidding? We're short of aircraft as it is!' he said. 'There's only two regiments left of them, one in the Far East and one in Engels, and here you are demanding three aircraft!' Still, he promised that the request would be duly considered.

Eventually permission was granted and three operational 3MN-2 tankers (tactical codes unknown, c/ns 9301402, 9301502 and 9301504) were turned over to the OKB in 1979. Before conversion the airframes were given a thorough check for fatigue cracks and deformations, and any defective parts were replaced; this work was performed by TsAGI and SibNIA under the supervision of Myasishchev OKB engineers.



Above: Another air-to-air of VM-T CCCP-01402 in post-upgrade days. The 'payload 1GT' is again a mock-up, as indicated by the weathered appearance.

Conversion work started in 1978. Airframe c/n 9301504 was earmarked as the static test article, while the other two were to be completed to flying condition. The conversion job was a large-scale co-operative effort undertaken by MAP and the Ministry of Defence Industry (MOM – *Ministerstvo oboronnoy promyshlennosti*). The other participants were the Moscow Machinery Plant named after Mikhail V. Khrunichev, the 'Polyot' (Flight) Omsk Aircraft Production Association (MAP plant No. 166), the 'Strela' (Arrow) Orenburg Machinery Plant, the Kuibyshev aircraft factory (MAP plant No. 18) and the Tashkent Aircraft Production Association named after Valeriy P. Chkalov (MAP plant No. 84). These enterprises supplied shipsets of internal structural members and skin panels for the VM-T's rear fuselage and tail unit, some long components of the centre fuselage

CCCP-01502 takes off from Zhukovskiy, taking a Buran to Baikonur. Unlike c/n 0.03, this Buran has most of the heat-resistant quartz tiles in place.

structure, lower wing skin reinforcement panels, rear fuselage and tail unit assembly jigs, etc. The main part of the work (reinforcement of upper wing skins and wingtip outrigger strut fairings, systems integration, design and manufacture of the jigs for the centre fuselage, outrigger strut fairings and the static test airframe's outer wings, manufacture of some crucial airframe components and final assembly of all three airframes) was the responsibility of the Experimental Machinery Plant.

On 14th October 1978 Vladimir M. Myasishchev passed away at the age of 76. *In memoriam* the 3M-T was redesignated VM-T (VM stood for Vladimir Myasishchev), while the Experimental Machinery Plant was named after its founder. Later the VM-T received a popular name, ***Atlant*** (Atlas in Greek mythology), as a reference to its impressive lifting capacity. The name was a fitting one: Atlas was doomed to hold up the sky till the end of time, while the VM-T was 'doomed' to uplift vehicles designed to go skywards.

After Myasishchev's death the enterprise continued working under the direction of acting Chief Designer V. A. Fedotov who was officially appointed Chief Designer by an MAP order on 23rd May 1979. Fedotov was a disciple of Myasishchev, and within the first three months he showed clearly that his choice as the new Chief Designer was a good one. He managed to keep up the traditional Myasishchev approach to aircraft design characterised by creative endeavour and engineering daring; it was this approach that allowed the extremely complex transport aircraft project to be completed within an incredibly short time.

Final assembly proceeded in Zhukovskiy. Interestingly, modification work on the centre fuselage structure and wing assembly was performed without jigs, allowing the first flying example to enter test 18 months after the commencement of the work and cutting conversion costs considerably. (This immediately brings to mind how the M-4 bomber was created in just 22 months.) The intensive and dedicated work of all the OKB's departments allowed the static test article to be completed in 1978, whereupon the fuselage of c/n 9301504 was delivered for destructive testing to TsAGI and the wings to SibNIA. The main effort – construction of the two flying examples, that is – took place in 1979.

Aptly registered CCCP-01402, the first flying VM-T (c/n 9301402) underwent a complete cycle of ground system tests in no-load configuration (the so-called 'autonomous configuration') between December 1980 and April 1981. The aircraft wore the full 1973-standard blue/white livery of Aeroflot Soviet Airlines and additional Aviaspetstrans titles; this was the name of a consortium (of which the Myasishchev OKB was a co-founder) established for airlifting unusual loads.

On 30th March the aircraft moved under its own power for the first time; this was followed by a series of high-speed taxi runs. Finally, on 29th April 1981 the VM-T made a successful first flight: the test crew comprised captain Anatoliy P. Kucherenko, co-pilot N. N. Gheneralov, navigator S. Sokolov, co-navigator I. Semookhin, flight engineer B. Ayzatoolin and radio operator V. Padookov. Interestingly, V. V. Ootkin, the then Director of LII-cum-Chairman of MAP's Methodical Council (a body whose functions included authorising the flight tests of new aircraft types), stated bluntly when the VM-T's first flight clearance was being considered that a flight of this aircraft with an external load would only take place over his dead body!

On its maiden flight the VM-T experienced auto-oscillations of the rear fuselage caused by the rudder control runs not being properly balanced. The remedy was to add a 30-kg (66-lb) load-carrying control rod in the rear fuselage. By the end of 1981 CCCP-01402 had made 19 test flights – all in no-load configuration.

Tests with external loads were the next item on the agenda. In October 1981 the aircraft underwent ground tests with a mock-up of the Energiya SLV's fuel tank/main module attached. Taxying tests commenced on 5th October; on 11th October and 19th December CCCP-01402 made a series of runs

VM-T CCCP-01402 with an almost completely 'clothed' Buran (or, more probably, *the* Buran which would later make the sole orbital flight) is refuelled before a flight. The orbiter's carbon/carbon nose cap has yet to be fitted.

which speed was gradually increased. On 18th December, after carefully analysing the data presented by the OKB, MAP's Methodical Council gave the go-ahead for flight tests of the VM-T in this configuration.

The first flight in loaded configuration was due to take place before the end of the year but had to be postponed several times due to foul weather. The breakthrough finally came on 6th January 1982 when the VM-T successfully flew with a mock-up of the Energiya's fuel tank – the so-called 'payload 1GT', the letters denoting *grooz tekhnologicheskiy* (technological cargo). The crew was the same one that had performed the type's maiden flight.

Having proved that the VM-T was indeed capable of fulfilling its intended mission, the test crew gradually 'taught it to fly' with all intended payload configurations, of which there were four. The abovementioned 'payload 1GT' was a cylindrical tank 44.46 m (145 ft 10⅝ in) long and 7.78 m (25 ft 6¼ in) in diameter. It was pressurised with nitrogen to maintain its proper shape and the ends provided with fairings pressurised by the slipstream (the forward fairing was hemispherical and the rear one was ogival). 'Payload 2GT' represented a combination of the SLV's proper nose fairing and the unpressurised cylindrical module attached to the tank from below and carrying the main engines; this assembly was mounted back to front and provided with the same hemispherical forward fairing as in the previous case. 'Return payload 3GT' was the draggiest of all – a huge 'Easter egg' made up of the fuel tank's forward and rear fairings so that they could be returned to the factory for the next mission. The final and heaviest configuration was 'payload 0GT' – the Buran space shuttle. For the early test flights in this configuration the orbiter's vertical tail was detached to avoid a negative effect on the VM-T's directional stability.

'Payload 2GT' was first carried aloft in mock-up form by CCCP-01402 on 15th March 1982; later, test pilots N. N. Gheneralov and V. V. Arkhipenko flew the VM-T loaded with the real thing.

The second flying VM-T – again very appositely registered CCCP-01502 (c/n 9301502) – formally entered test on 25th January 1982. The aircraft was test flown in no-load configuration in March, proceeding to make its first flight with a mock-up 'payload 1GT' on 19th April that year. Between August and November both aircraft were in lay-up while modifications were made; upon completion the updated CCCP-01502 flew to Yubileynyy airfield (Leninsk) to undergo ground and flight tests with 'payload 3GT'. Less than a fortnight later, test pilots Anatoliy P. Kucherenko and Eduard N. Chel'tsov took the machine into the air with the 'Easter egg' on top. The tests went without a hitch – only three flights out of the planned eight were required to obtain the desired data. Thus on 28th December 1982 the aircraft could transport a 'payload 3GT' from Leninsk to Kuibyshev (now renamed back to Samara).

Table 1. Weights and dimensions of the VM-T's payload options

Payload	Weight, kg (lb)	Length	Diameter
1GT	31,500 (69,440)	44.46 m (145 ft 10⅝ in)	7.78 m (25 ft 6¼ in)
2GT	30,000 (66,140)	26.41 m (86 ft 7⅝ in)	7.75 m (25 ft 5⅛ in)
3GT	15,000 (33,070)	15.67 m (51 ft 5 in)	7.75 m (25 ft 5⅛ in)
0GT	45,300 (99,870)*	38.45 m (126 ft 1¼ in)	23.8 m (78 ft 1 in)†

** later increased to 50 tons (110,230 lb); † wing span*

Table 2. 3M-T specifications according to ADP documents

	no load	w. payload 0GT	w. payload 1GT	w. payload 2GT	w. payload 3GT
TOW (incl. 50 tons of fuel), kg (lb),	139,200 (306,880)	187,000 (412,260)*	170,500 (375,880)	169,000 (372,575)	152,200 (335,540)
Landing weight, kg (lb)	116,200 (256,170)	138,500 (305,335)	129,500 (285,490)	128,000 (282,190)	111,200 (245,150)
Operating empty weight (w/o fuel or ballast), kg (lb)	81,200 (179,010)	126,500 (278,880)	112,700 (248,460)	111,200 (245,150)	96,200 (21,210)
Payload, kg (lb)	none	45,300 (99,870)	31,500 (69,440)	30,000 (66,140)	15,000 (33,070)
Ballast fuel, kg (lb)	5,000 (11,020)	none	4,800 (10,580)	4,800 (10,580)	3,000 (6,610)
Required runway length, m (ft)	n.a.	n.a.	3,500 (11,500)	n.a.	n.a.
Range, km (miles)	3,600 (2,240)	n.a.	n.a.	1,500+ (930+)	n.a.
Speed, km/h (mph)	500-600 (310-372)				

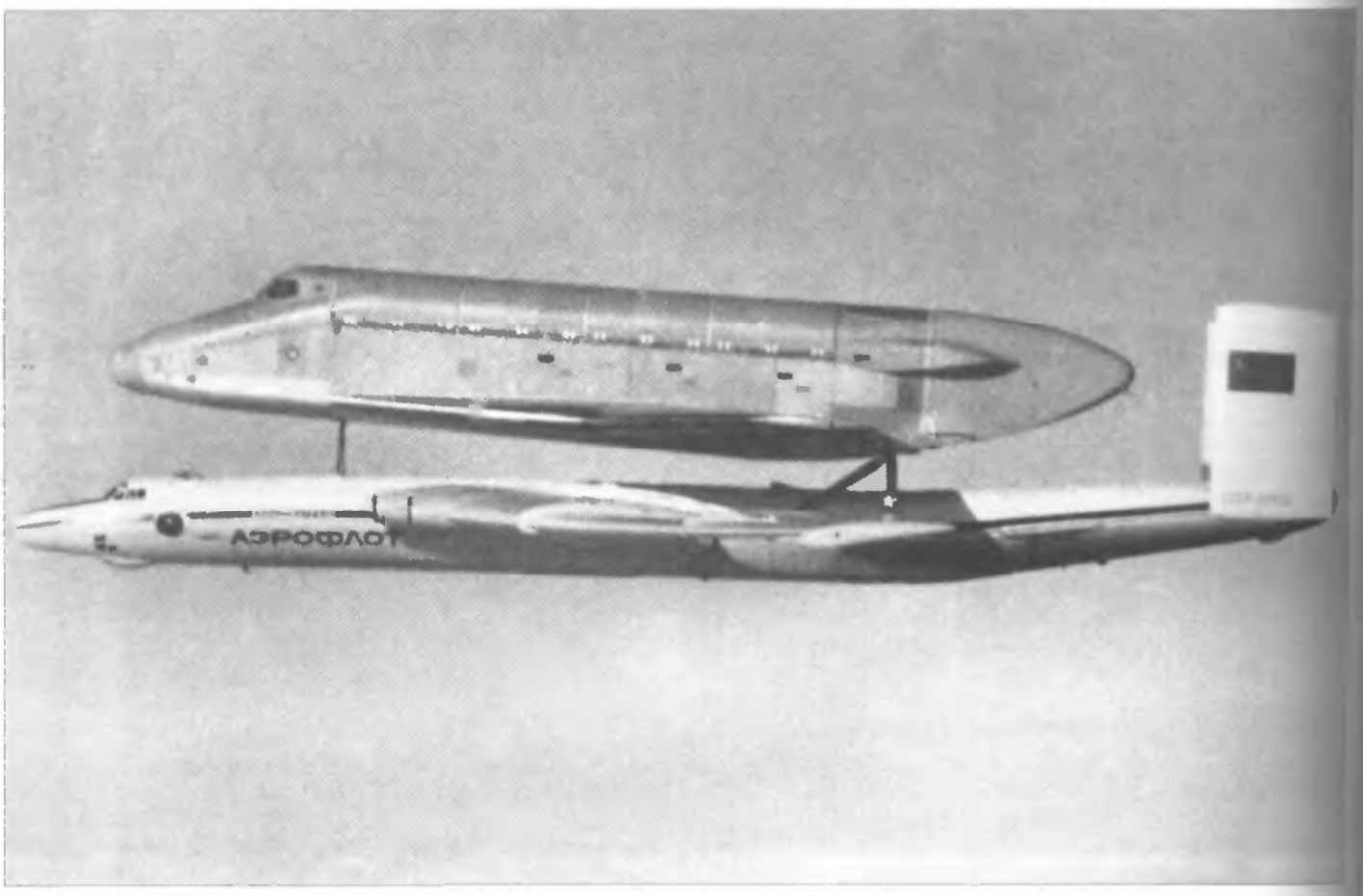
** with a fuel load of 60 tons (132,275 lb)*

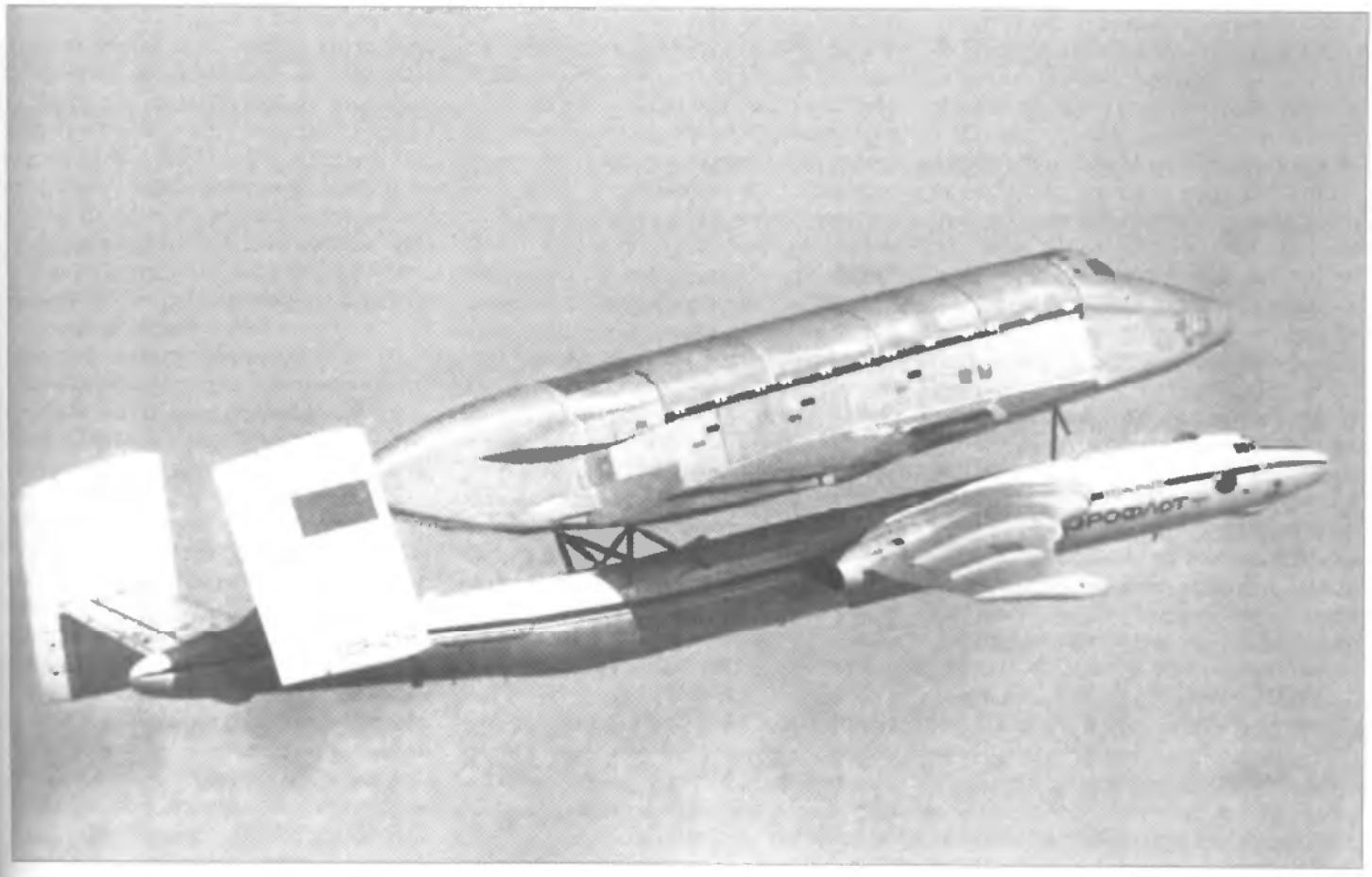
In February 1983 the VM-T began ground tests with the third airframe of the Buran space shuttle (*izdeliye* 11F35); on 1st March Kucherenko and Chel'tsov performed the VM-T's first flight with the 45.3-ton (99,870-lb) spacecraft on top. However, the grand occasion was preceded by a minor accident when the shuttle carrier ran off the paved taxiway and the nose gear sank into the soft mud; when the ground crew tried to jerk the aircraft free with a tug the nose gear collapsed, the forward fuselage underside suffering considerable damage. Not until the Buran was lifted clear could the VM-T be towed to a hardstand for repairs.

Generally the tests proceeded at an unprecedentedly brisk pace; however, even though the VM-T was a derivative of the proven 3M bomber, it did give a few nasty surprises. On one occasion after a generous bootful of rudder, the rear fuselage started oscillating dangerously with an amplitude of up to 250 mm (nearly 10 in). It should be noted that the length of the control runs had increased as compared to the 3M because of the greater fuselage length (as the reader will remember, the VM-T was 7 m longer). This probably caused delays between control inputs and elevator/rudder deflection, leading to oscillations. Had the aircraft retained the bomber's reversible control actuators, the obvious thing to do would have been to switch them off and go to manual mode in order to stop the oscillation. Under the circumstances, however, the only correct thing to do was to kill the speed and be extremely gentle with the controls.

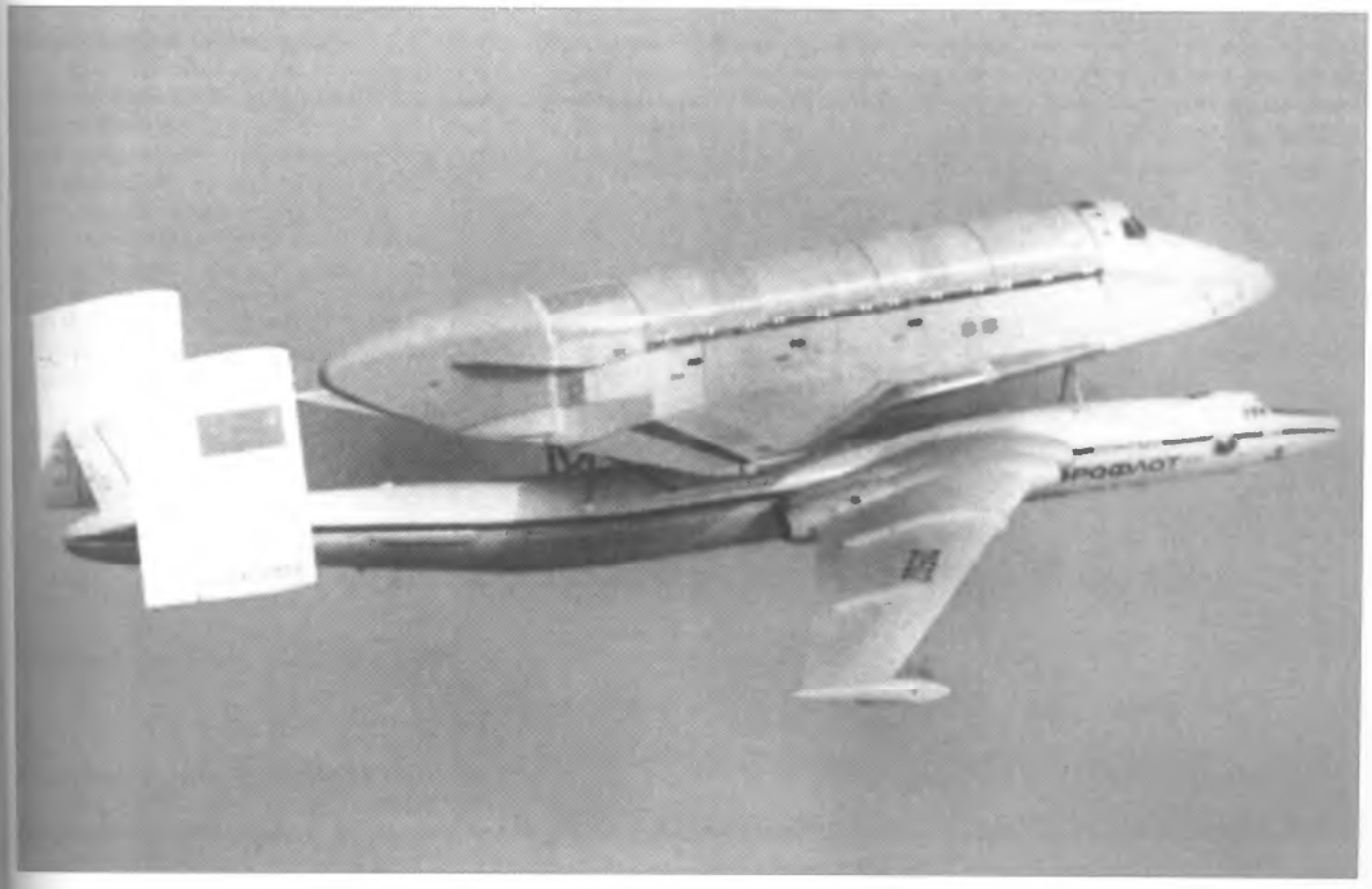
The VM-T as such had a high lift/drag ratio, but the bulky and draggy external load ruined everything, reducing range dramatically. Besides, the large weight of the cargo meant the aircraft could not take off fully fuelled so as not to exceed MTOW restrictions. Hence the Atlant's range with a 31.5-ton (69,440-lb) payload was no more than 1,700 km

Above: CCCP-01502 taxies over the 'piano keys' of a wintry runway at Zhukovskiy with natural metal Buran c/n 0.03 on top.
Below: The same pair in flight: makes you wonder who's carrying whom! Seriously, the VM-T's ability to shoulder such loads is truly impressive.





Above and below: Two more air-to-airs of VM-T CCCP-01502 carrying Buran c/n 0.03, showing the shuttle orbiter's wing shape and the design of the boat-tail fairing covering the rocket motor nozzles.



(1,055 miles), necessitating a refuelling stop in Kuibyshev en route from Moscow to Baikonur. The only way to remedy this was to install an IFR system (the 3MN-2s set aside for conversion had none), and the first VM-T (CCCP-01402) was upgraded in the 1980s.

The first flying prototype of the Buran space shuttle arrived at Baikonur on 23rd March 1988 atop a VM-T transport. About 300 km (186 miles) from the destination the aircraft developed a fuel leak, forcing the No. 2 engine to be shut down to reduce the fire hazard. However, it never rains but it pours: when the aircraft was on long finals to Yubileynyy the generator circuits failed one by one, leaving the DC batteries as the sole source of electrical power. Luckily the landing gear was down by then but the flaps could not be extended now; to top it all, the No. 1 engine also flamed out as the VM-T sideslipped. The situation was truly catastrophic now; the huge freighter with an equally huge 'thunderbird' on top came in to land with the speed of a fighter. Yet Anatoliy P. Kucherenko and Eduard N. Chel'tsov managed a smooth two-point landing with the utmost precision.

It should be noted here that a group of six Myasishchev OKB engineers managed the greater part of the work under the *izdeliye* 3-35 programme. They were: V. A. Korchagin, V. M. Kirillin, A. I. Nikonov, I. M. Feighel'man, R. V. Zaïtsev and R. V. Glooshkova.

Meanwhile, the Antonov OKB finally did design, build and successfully test the unique An-225 freighter specially designed for supporting the Energiya/Buran multi-purpose rocket space transport system (registered CCCP-480182, later CCCP-82060, c/n 01-01). Naturally, competitive juices ran riot. The Antonov OKB could not pretend the VM-T did not exist, of course, but they often did try to 'play down' the importance of the effort the Myasishchev OKB had undertaken with this aircraft. For instance, An-225 chief project engineer A. G. Vovnyanko wrote: *'Another aircraft used for this kind of transport operations was an upgraded 201M* (this is how the 3M bomber was called by the Soviet popular press in the days when military censorship was really strict – *Auth.*). *It delivered large components of spacecraft to Baikonur; yet this was the best amateurs could do in this field.'* (Amateurs, indeed! It's a real shame that good aviation engineers never have a word of praise to say for the competition – *Auth.*) Yet it was the VM-T that made possible both the first launch of the Energiya (loaded with a 100-ton (220,450-lb) satellite on that occasion) and the first and only flight of the Buran. Between them the two Atlants made more than 150 trips to Baikonur, carrying components of the Energiya/Buran system.

Incredibly, the entire job of converting three tankers into VM-T transports cost only 60 million roubles in 1980 prices! By comparison, building a factory at Baikonur with the purpose of manufacturing the Energiya SLV on site would have cost billions.

It would seem the new space transport system's unmatched capabilities assured it a bright future. Yet even as the programme reached fruition the clouds began to gather. The first launch of the Energiya ended in a setback. The rocket functioned perfectly, but then an error in the satellite's software caused the satellite to decelerate instead of accelerating and fall into the Atlantic Ocean. According to some sources, the losses ran to nearly 100 million 'hard currency roubles' (a sort of 'semi-hard' currency used by the USSR for foreign settlements). Then came the political and economic crises of the late 1980s and early 1990s; the demise of the Soviet Union and the ensuing series of botched economic reforms drove most of the nation's major scientific and defence programmes into the ground. Only those programmes which managed to attract Western interest survived.

In 1992 the Myasishchev OKB began development of the Demonstrator multi-stage space-launch system based on the VM-T as a joint effort with TsAGI and the engine manufacturer NPO Saturn. The aircraft was to carry a sub-orbital launch vehicle powered by two D-57 cryogenic fuel rocket motors; these were, in fact, developed by Arkhip M. Lyul'ka back in the 1960s for the ill-starred N1 lunar rocket. The vehicle, in turn, carried a Western aerospaceplane (Norus, British Aerospace HOTOL or the like) or a disposable launch rocket with a satellite. It could also be used as a launch vehicle for a hypersonic drone or as an engine testbed. By using existing rocket motors the Demonstrator could be used to investigate such complex problems as in-flight starting of liquid oxygen/liquid hydrogen (LOX/LH_2) rocket motors running on cryogenic fuel, stage separation dynamics, remote control of an unmanned space system at the orbit entry, de-orbiting and automatic landing stages; maintenance technologies could be devised, etc. Using the VM-T as the carrier aircraft offered substantial cost savings during space transport system and propulsion technology development. At the same time, revenue could be generated by launching small satellites; the Demonstrator could thus compete successfully with the US Orbital Sciences Corporation (OSC) Pegasus sub-orbital launch system (based on the B-52 and the Lockheed L-1011 TriStar widebody airliner) and the Russian Burlak sub-orbital launch system using the Tupolev Tu-160SK *Blackjack* bomber.

From 11-16th August 1992 the second VM-T (by then sporting an altered registration РФ-01502, with the unofficial Russian prefix RF in Cyrillic characters) was displayed at the MosAeroShow-92 at Zhukovskiy – the first real Russian air show. It was probably then that the first attempts were made to secure funds for full-scale development of the Demonstrator system. Initially the system seemed to attract considerable interest, but the harsh reality was that no real money was forthcoming; the Russian government either had no money or was not about to earn money that way. Thus ended sadly the story of an aircraft which without doubt belongs in Russian aviation's hall of fame.

By August 1993 VM-T CCCP-01502 had gained 'Atlant' (Atlas) titles, the Russian flag on the tails and the non-standard registration prefix RF. It is seen here at Zhukovskiy during the MAKS-99 airshow.

Main specifications of OKB-23's long-range bombers (the M-4/3M family)

Type	'Aircraft M'	M-4	M-4	M-4	M-4-2	2M (*izdeliye 28*)
Year of development	1951	1953	1954	1956	1956	1953
Status	Project	Prototype	Production	Production	Production	Project
Powerplant	4 x Mikulin AM-03	4 x Mikulin AM-3A	4 x Mikulin AM-3A	4 x Zoobets RD-3M-500A	4 x Zoobets RD-3M-500A	4 x Dobrynin VD-5
Take-off thrust, kgp (lb st)	4 x 8,500 (4 x 18,740)	4 x 8,750 (4 x 19,290)	4 x 8,750 (4 x 19,290)	4 x 9,500 (4 x 20,940) *	4 x 9,500 (4 x 20,940) *	4 x 13,000 (4 x 28,660)
Empty weight, kg (lb)	70,000 (154,320)	n.a.	79,700 (175,705)	80,000 (176,370)	80,000 (176,370)	90,000 (198,410)
Take-off weight, kg (lb):						
normal	118,000 (260,140)	131,800 (290,560)	138,500 (305,335)	140,000 (308,640)	140,000 (308,640)	n.a.
maximum	155,000 (341,710)	181,500 (400,130)	181,500 (400,130)	184,500 (406,750)	184,500 (406,750)	200,000 (440,920)
Top speed at optimum cruise altitude, km/h (mph)	950 (590)	962 (597) † / 950 (590) ‡	947 (588)	947 (588)	950 (590)	950 (590)
Service ceiling, m (ft)	13,000-14,000 (42,650-45,930)	12,500 (41,010)	11,000 (36,090)	11,000 (36,090)	11,000 (36,090)	17,000 (55,770)
Range on internal fuel, km (miles) §	12,000-13,000 (7,450-8,075)	9,800 (6,090)	8,100 (5,030)	8,000+ (4,970+)	4,000 ¶ (2,480)	12,000 (7,450)
Take-off/landing run, m (ft)	1,500/2,200 (4,920/7,220)	n.a.	1,470/2,610 (4,820/8,560)	1,500/2,610 (4,920/8,560)	1,500/2,610 (4,920/8,560)	n.a.
Maximum payload, kg (lb)	24,000 (52,910)	24,000 (52,910)	24,000 (52,910)	24,000 (52,910)	40,000 (88,180) ‖	24,000/27,000 (52,910/59,520)
Thrust/weight ratio at MTOW	0.22	0.19	0.19	0.21	0.21	0.26
Take-off wing loading, kg/m² (lb/sq. ft)	470 (96)	556 (114)	556 (114)	565 (115)	565 (115)	500 (102.5)
Wing area, m² (sq. ft)	326.35 (3,509)	326.35 (3,509)	326.35 (3,509)	326.35 (3,509)	326.35 (3,509)	400 (4,300)
Wing span w. landing gear fairings	50.53 m (165 ft 9¼ in)	50.53 m (165 ft 9¼ in)	50.53 m (165 ft 9¼ in)	50.53 m (165 ft 9¼ in)	50.53 m (165 ft 9¼ in)	55 m (180 ft 5¾ in)
Length, less IFR probe	50 m (164 ft ½ in)	48.7 m (159 ft 9⅝ in)	47.66 m (156 ft 4½ in)	47.66 m (156 ft 4½ in)	47.66 m (156 ft 4½ in)	n.a.

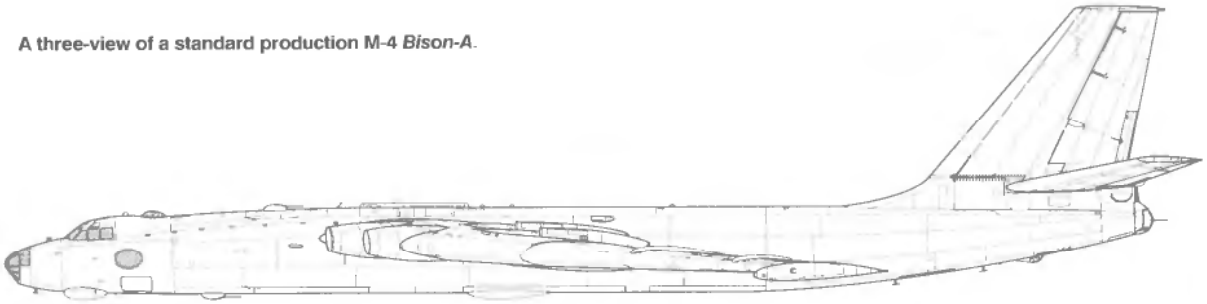
* 10,500 kgp (23,150 lb st) at contingency rating † Manufacturer's flight tests ‡ State acceptance trials § With a normal payload ¶ Combat radius ‖ Transferable fuel

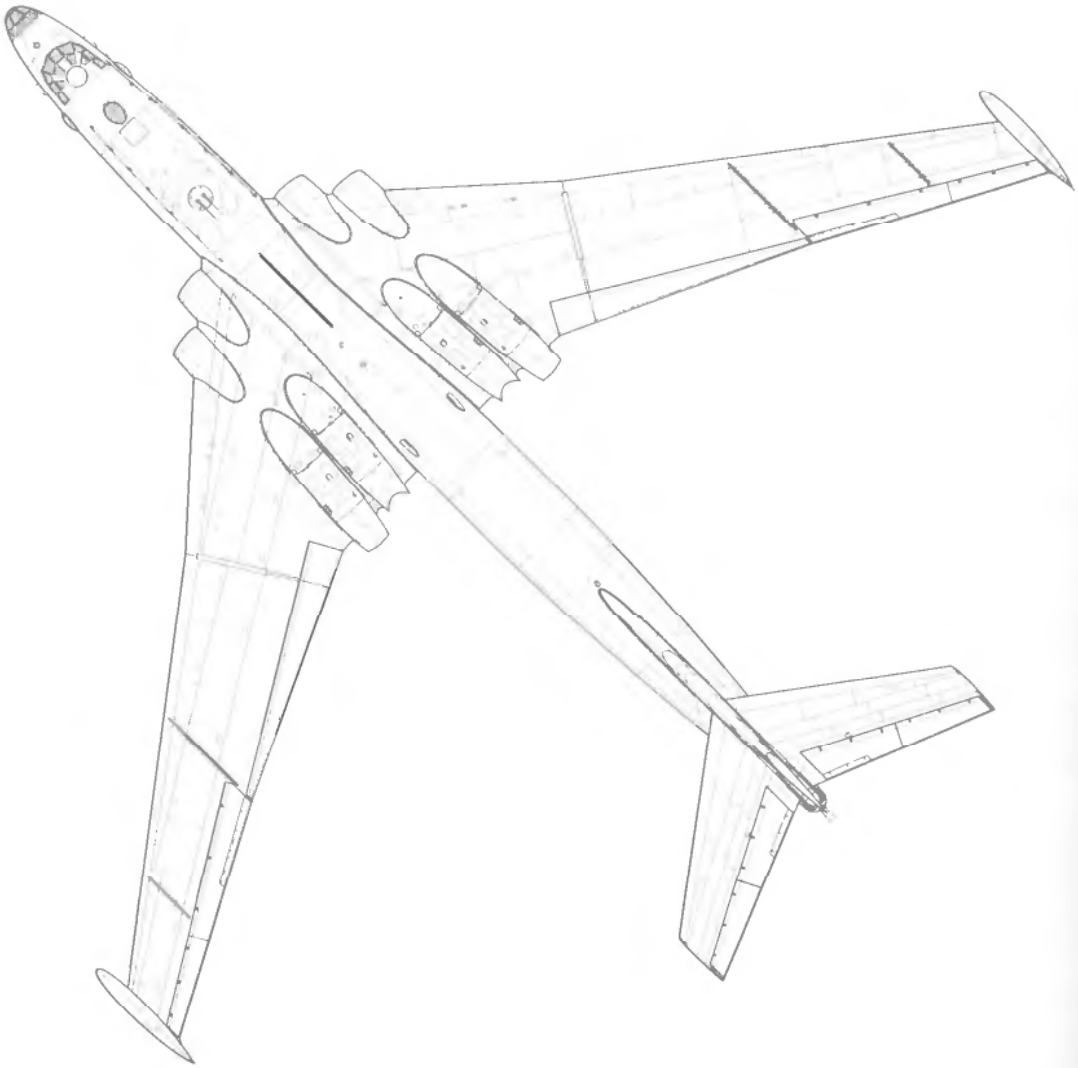
Main specifications of OKB-23's long-range bombers (continued)

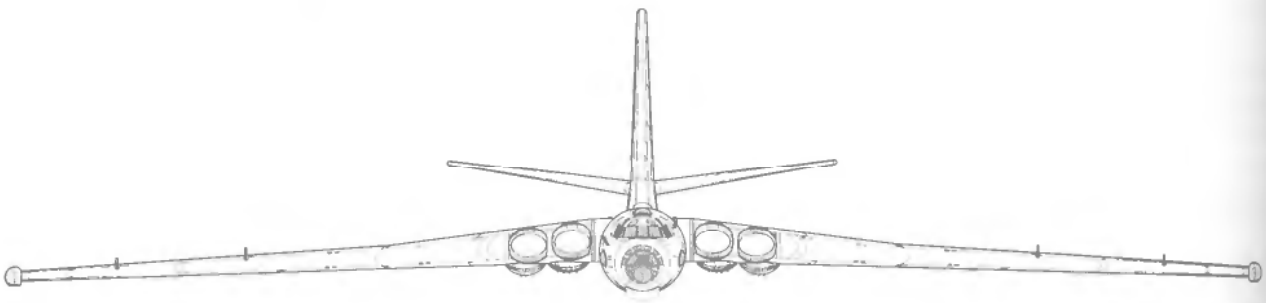
Type	3M	3MN-1	3MS-1	3MN-2	3MD	M-29 (M-6P)	VM-T
Year of development	1956	1956	1958	1960	1960	1956	1982
Status	Prototype	Production	Production	Production	Production	Project	Operational
Powerplant	4 x Dobrynin VD-7	4 x Dobrynin VD-7B	4 x Zoobets RD-3M-500A	4 x Dobrynin VD-7B	4 x Dobrynin VD-7B	4 x Dobrynin VD-7	4 x Dobrynin VD-7MD
Take-off thrust, kgp (lb st)	4 x 11,000 (4 x 24,250)	4 x 9,500 (4 x 20,940)	4 x 9,500 (4 x 20,940)	4 x 9,500 (4 x 20,940)	4 x 9,500 (4 x 20,940)	4 x 11,000 (4 x 24,250)	4 x 10,750 (4 x 23,700)
Empty weight, kg (lb)	74,430 (164,090)	75,740 (166,975)	76,000 (167,550)	75,700 (166,890)	76,800 (169,310)	90,000 (198,410)	78,700 (173,500)
Take-off weight, kg (lb):							
normal	150,000 (330,690)	140,000 (308,640)	140,000 (308,640)	140,000 (308,640)	145,600 (320,990)	n.a.	136,200 (300,260)
maximum	203,500 (448,630)	193,000 (425,485)	193,000 (425,485)	193,000 (425,485)	193,000 (425,485)	200,000 (440,920)	200,000 (440,920)
Top speed at optimum cruise altitude, km/h (mph)	940 (583)	925 (575)	925 (575)	910 (565)	970 (602)	900 (560)	580 (380) (cruise)
Service ceiling, m (ft)	n.a.	12,250 (40,190)	12,250 (40,190)	12,250 (40,190)	12,000 (39,370)	10,000 (32,810)	10,200 (33,465)
Range on internal fuel, km (miles) †	12,000 (7,450)	11,800 (7,330)	10,500 (6,520)	5,500 ‡ (3,415)	10,950 (6,800)	10,000 (6,210)	3,565 (2,214)
Take-off/landing run, m (ft)	1,650/2,800 (5,410/9,190)	1,700/2,800 (5,580/9,190)	1,700/2,800 (5,580/9,190)	1,700/2,800 (5,580/9,190)	1,700/3,000 (5,580/9,840)	n.a.	n.a.
Maximum payload, kg (lb)	18,000 (39,680)	18,000 (39,680)	18,000 (39,680)	46,000 (101,410) §	18,000 (39,680)	30,000 (66,140) (200-250 persons)	32,000 (70,550) ¶
Thrust/weight ratio at MTOW	0.22	0.2	0.2	0.2	0.2	0.2	0.22
Take-off wing loading, kg/m² (lb/sq. ft)	576 (118.5)	549 (112.5)	549 (112.5)	549 (112.5)	520 (106)	570 (117)	n.a.
Wing area, m² (sq. ft)	351.78 (3,782)	351.78 (3,782)	351.78 (3,782)	351.78 (3,782)	370 (3,980)	351.78 (3,782)	351.78 (3,782)
Wing span	53.14 m (174 ft 4⅛ in)	53.14 m (174 ft 4⅛ in)	53.14 m (174 ft 4⅛ in)	53.14 m (174 ft 4⅛ in)	53.14 m (174 ft 4⅛ in)	53.14 m (174 ft 4⅛ in)	53.14 m (174 ft 4⅛ in)
Length, less IFR probe	48.76 m (159 ft 11⅝ in)	48.76 m (159 ft 11⅝ in)	48.76 m (159 ft 11⅝ in)	48.76 m (159 ft 11⅝ in)	49.20 m (161 ft 5 in)	47.50 m (155 ft 10 in)	51.23 m (168 ft 1 in)

* 10,500 kgp (23,150 lb st) at contingency rating § With a normal payload ‡ Combat radius § Transferable fuel ¶ Buran space shuttle

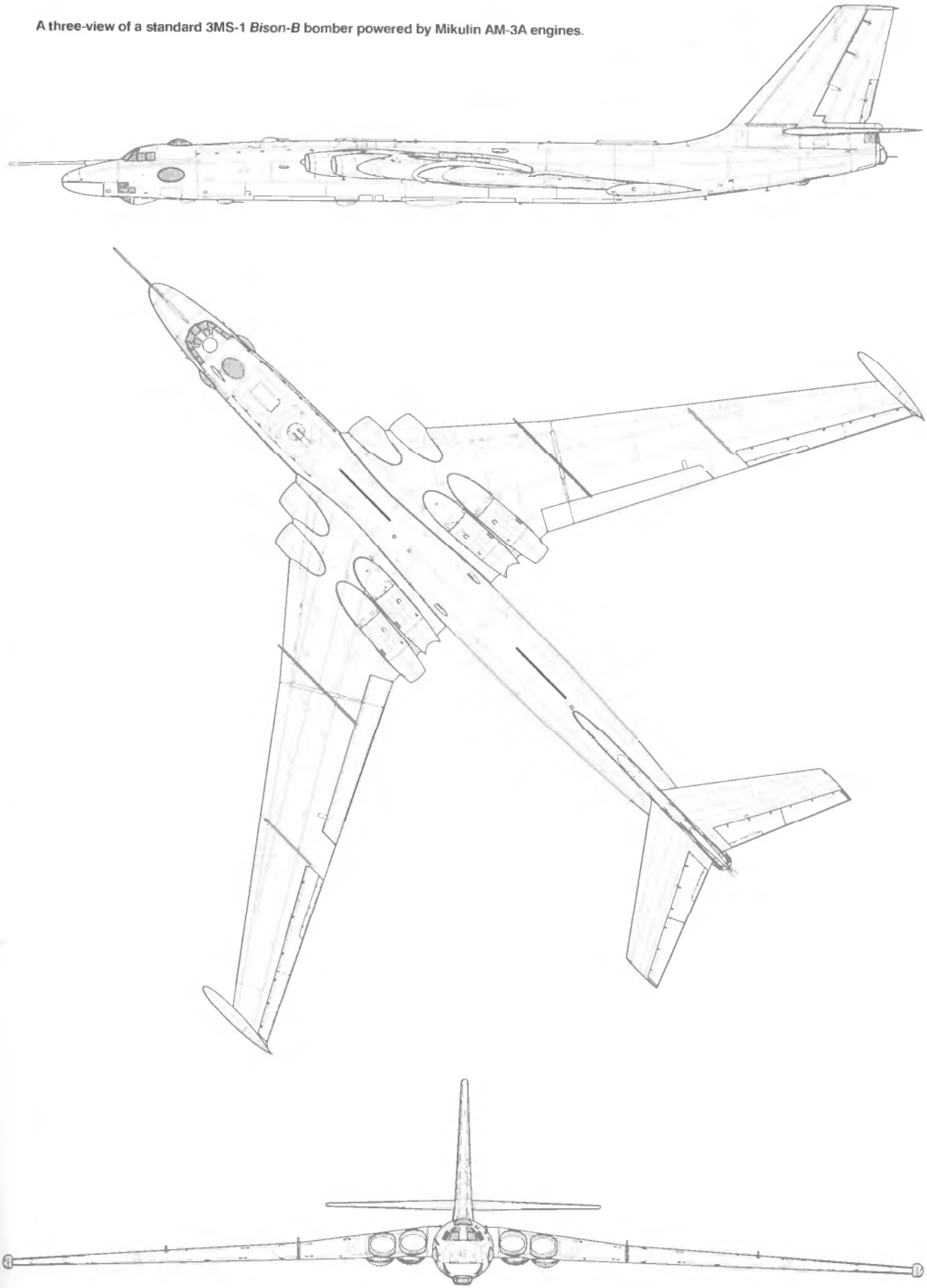
A three-view of a standard production M-4 *Bison-A*.



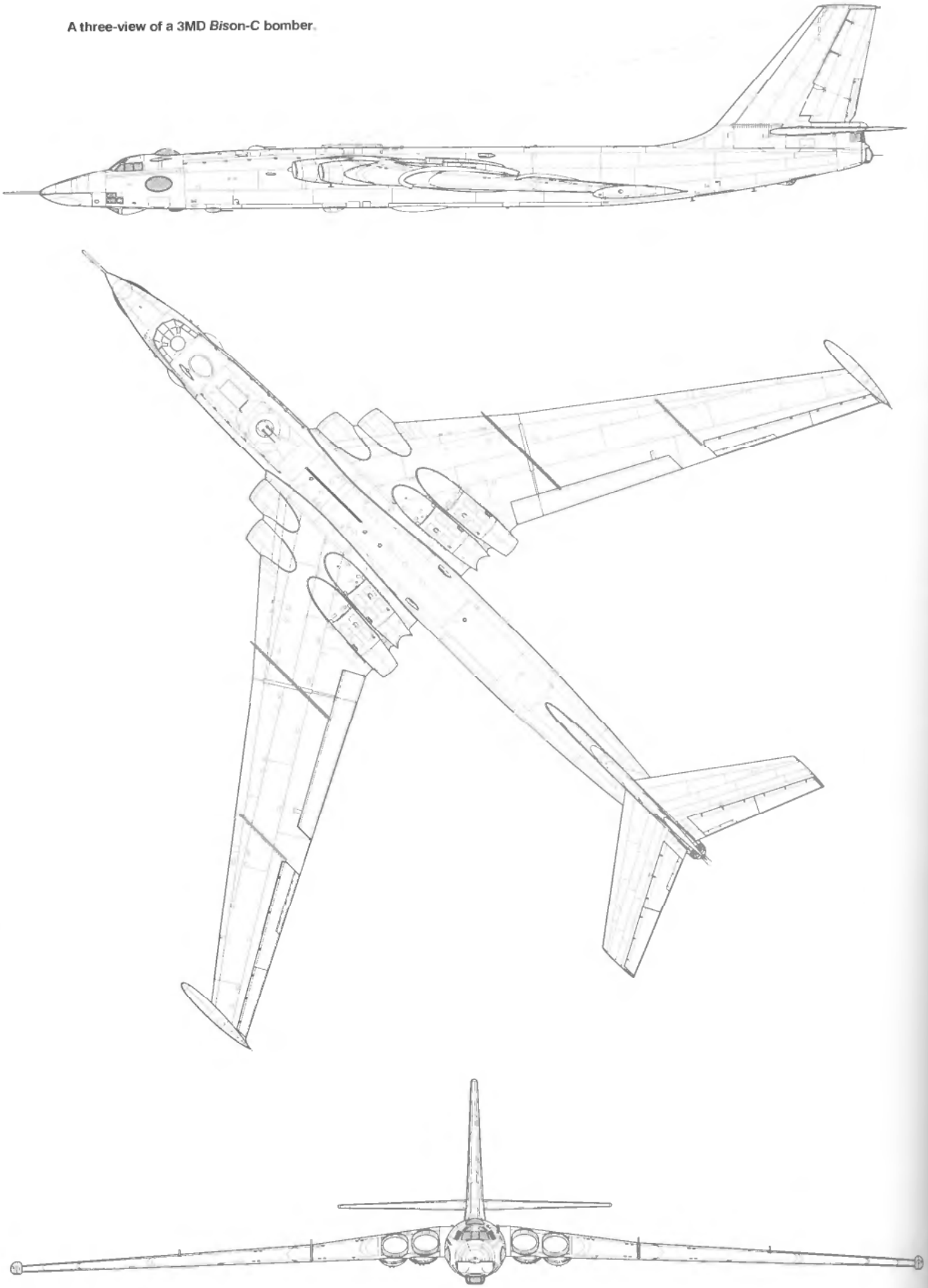


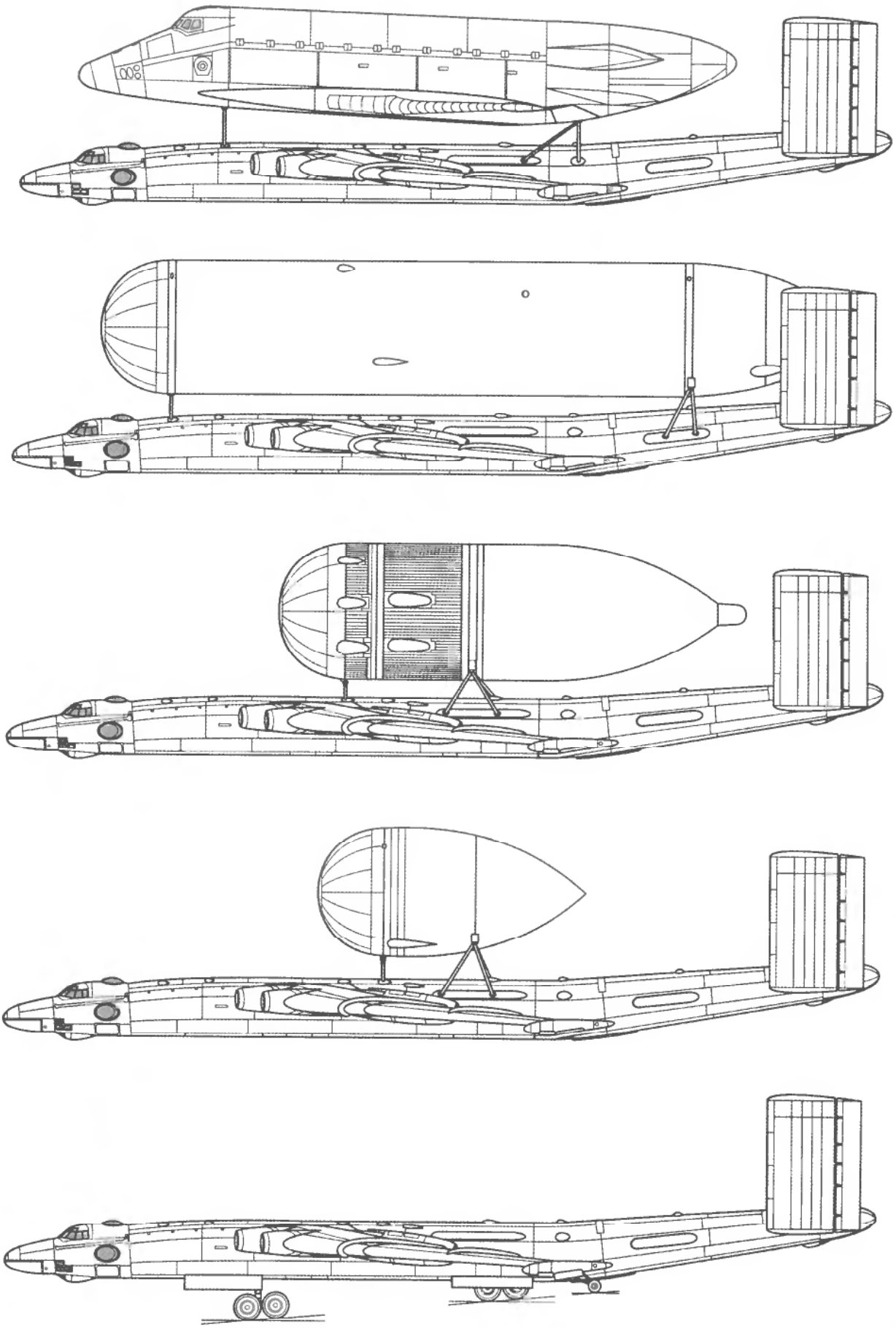


A three-view of a standard 3MS-1 *Bison-B* bomber powered by Mikulin AM-3A engines.



A three-view of a 3MD *Bison-C* bomber.





The VM-T transport aircraft with, top to bottom: 'payload 0GT' (the Buran orbiter with the vertical tail detached); 'payload 1GT' (the fuel tank of the Energiya SLV); payload 2GT' (the Energiya's lower module and nose fairing); 'payload 3GT' (the nose and rear fairings of the Energiya's fuel tank); and in no-load configuration.

Above: 3MS-2 '37 Red' at Dyaghilevo AB near Ryazan', home of the 43rd Combat & Conversion Treining Centre. Part of the port wing leading edge is missing.
Below: This view illustrates the *Bison*'s sleek appearance in e head-on view. Note how the 'antl-radiation' white colour is wrapped around the wing leading edge.

Above and below: '14 Red' (c/n 7300805), a 1230th APSZ 3MS-2 parked at Engels-2 AB around 1993 with a tarpaulin over the flightdeck to protect the glazing against the ultraviolet radiation of the sun. Note the characteristic kinked shape of the colour division line between the white belly and the natural metal top.

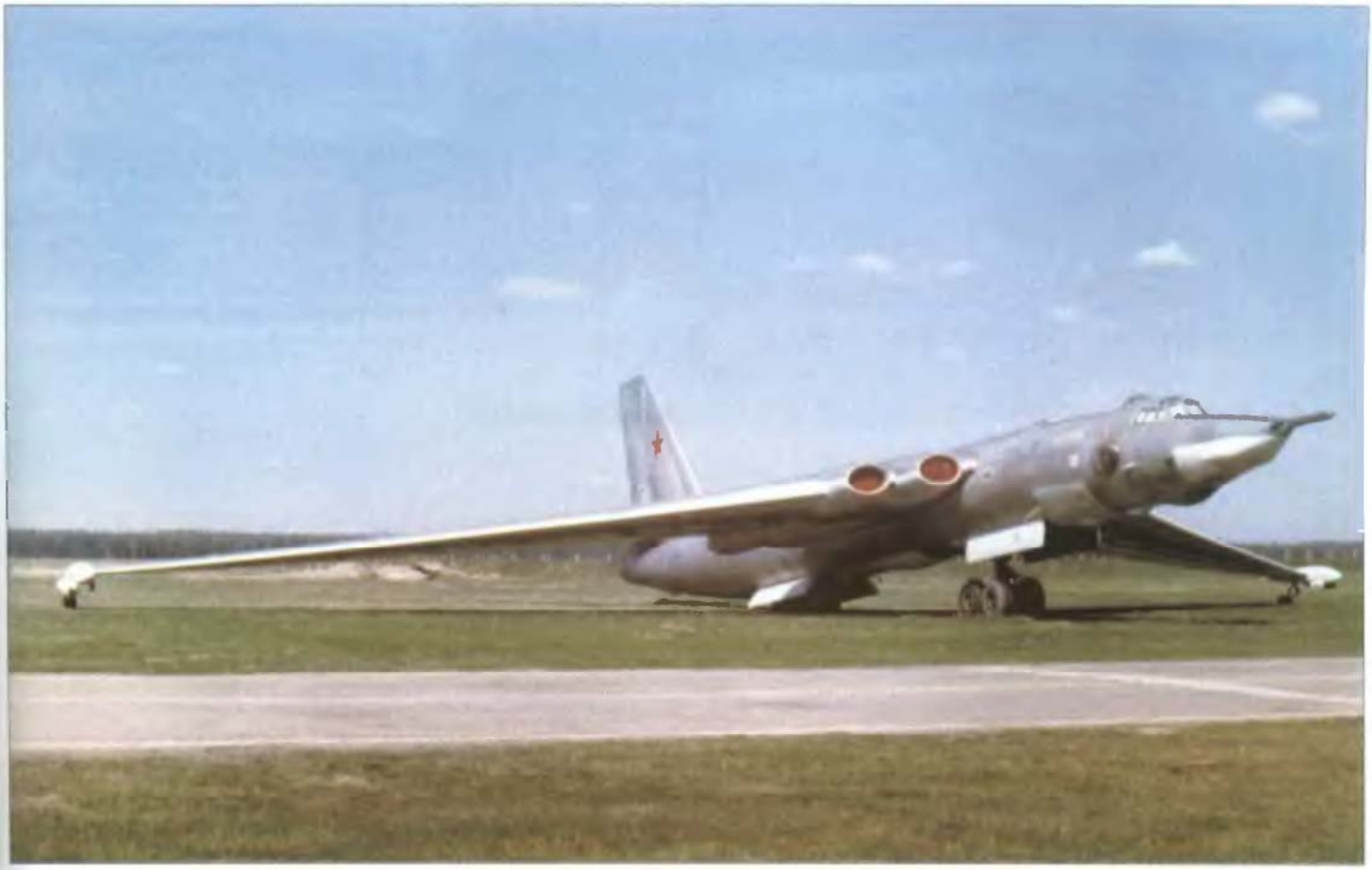
Above: A view of 3MS-2 '37 Red' at Dyaghilevo AB, showing the weathered finish of this aircreft. Note the hangar of the 360th Aircraft Overhaul Plant beyond.
Below: Another 3MS-2 tanker at Dyaghilevo (coded '15 Red') is in rather better shepe. Note the Tu-22PD ECM aircraft and Tu-22M3 bomber in the background.

Above: The 1230th APSZ flight line at Engels-2 AB packed with 3MS-2s awaiting disposal. Note the patchwork appearance of '52 Red' second from the camera.
Below: A ground crewman cleans snow off a 3MN coded '36 Red'. The air outlets identifying the VD-7B engines are clearly visible.

Above: An evening scene at Engels-2 AB, with 3MS-2 '26 Red' (c/n 7300405) in the foreground. The flaps were usually left down when the *Bison* was parked.
Below: Two TZ-22 fuel bowsers carrying the number '1' on the cab door (probably the squadron number) about to fill up the tanks of a 3MN-2.

Stratospheric blue above, icy white below. This atmospheric shot of a 3MD taking on fuel from a *Bison* tanker was taken by the radio operator.

Above and below: The only surviving 3MD, '30 Red' (c/n 0301804, the last-but-one *Bi*son built) parked on the grass at the Central Russian Air Force Museum at Monino, with Il'yushin IL-62 *sans suffixe* CCCP-86670 visible in the background.



Above and below: Two more views of the 3MD at Monino. These photos accentuate the bomber's small ground clearance beneath the rear fuselage.

Left: A 'cherry picker' based on the early-1950s vintage ZIS-150 lorry is used to inspect the tail surfaces of a *Bison*-C. Unlike the 3MS and 3MN, 3MDs did not carry the construction number on the tail.

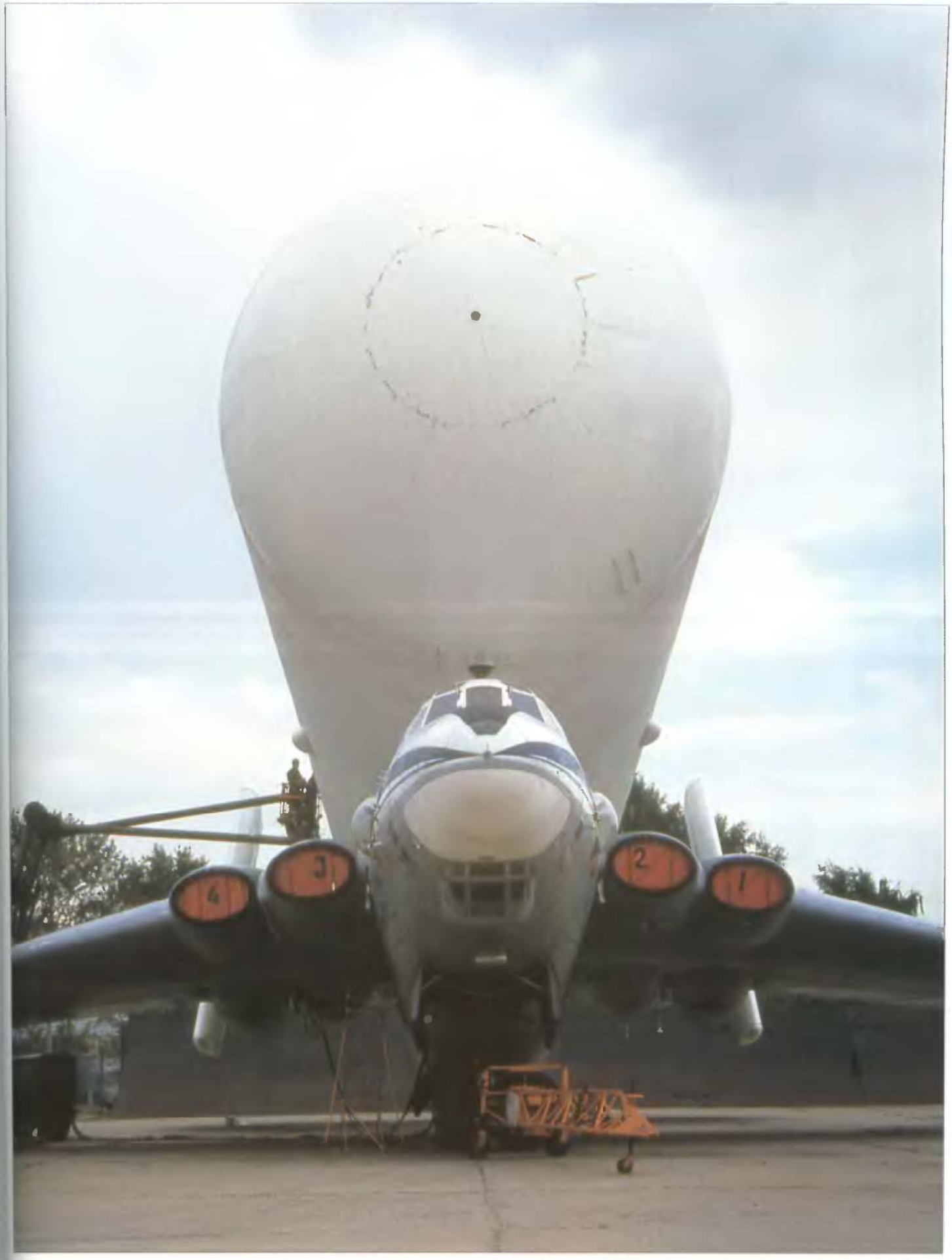
Below: A technician removes the air intake cover from a 3M; the covers were marked with the number of the respective engine because they were non-interchangeable. Note the taxi light on the nose gear door, the 'wet' pylon for a drop tank between the inner and outer engines and the curved colour division line. Soviet Air Force technicians were dubbed 'black men' because of their black fatigues.

Opposite, top: VM-T CCCP-01402 in no-load configuration sits in front of the Myasishchev hangar on the south side of the LII airfield in Zhukovskiy, surrounded by a jumble of ground support equipment.

Opposite, bottom: In 1993 the second VM-T gained a Russian flag on the tails, the unofficial RF- Russian registration prefix, Atlant (Atlas) titles and Myasishchev logos in place of the earlier Aviaspetstrans titles.

ВМ-Т
АТЛАНТ

Above and below: Two views of VM-T CCCP-01502 at Zhukovskly with a dummy 'payload 1GT' (Energiya SLV fuel tank) on top.
Right: This view accentuates the size of the payloads shouldered by the VM-T.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Above and below: VM-T CCCP-01502 makes a demonstration flyby at an airshow, carrying a dummy 'payload 1GT'. The retaining struts are clearly visible.

Above and below: They served together... and died together. The dump at Engels-2 AB (which is a disposal centre, among other things) is littered with the remains of scrapped bombers, including a 3M (on the left in the lower photo) and at least two Tu-95s.

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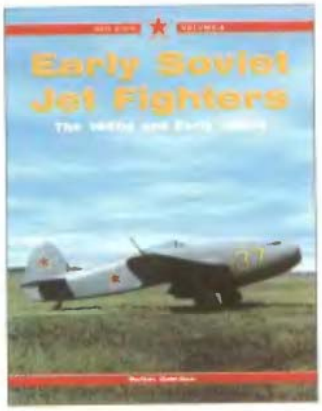

This charts the development and service history of the first-generation Soviet jet fighters designed by such renowned 'fighter makers' as Mikoyan, Yakovlev and Sukhoi, as well as design bureaux no longer in existence – the Lavochkin and Alekseyev OKBs, during the 1940s and early 1950s. Each type is detailed and compared to other contemporary jet fighters. As ever the extensive photo coverage includes much which is previously unseen.

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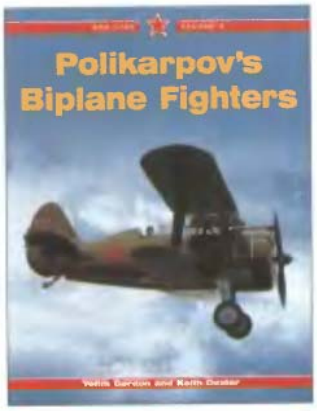

The development of Polikarpov's fighting biplanes including the 2I-N1, the I-3, and I-5, which paved the way for the I-15 which earned fame as the Chato during the Spanish Civil War and saw action against the Japanese; the I-15*bis* and the famous I-153 Chaika retractable gear gull-wing biplane. Details of combat use are given, plus structural descriptions, details of the ill-starred I-190, and of privately owned I-15*bis* and I-153s restored to fly.

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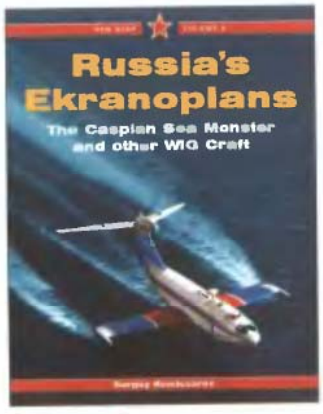

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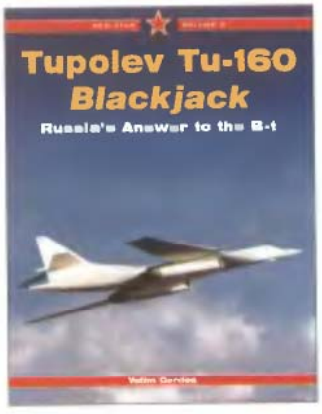

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